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FORTY-THIRD MEETING OF THE AMERICAN ASTRONOMICAL SOCIETY

The Society held its forty-third meeting in Cambridge, Massachusetts, from Monday, December 30, 1929, to Thursday, January 2, 1930, favored by pleasant weather and by an efficient local committee headed by Mr. Leon Campbell.

The Council assembled Monday evening in the Continental Hotel and remained in session until the bulk of the business had been disposed of. On Tuesday morning the members wandered about the deserted Harvard campus until they found the Jefferson Physical Laboratory where the first and two of the subsequent sessions were held.

In his opening remarks President Brown referred to the recent loss of R. H. Curtiss, one of the senior councilors, and the Society, by a standing vote, directed the Secretary to telegraph Mrs. Curtiss the sympathy of the members and their appreciation of the companionship they had enjoyed and now lost.

Eight papers were accepted in addition to those presented on the program, but the sessions proved too short to give them all. Messrs. Shapley, Duncan, and Schlesinger were called upon during the meeting to act as chairman. The reporters, who faithfully attended the sessions, found a total eclipse the one bright spot on the program. So enlivened was one that he urged his readers to give up tobacco the next day and start smoking glass. Mr. H. H. Plaskett worked faithfully and untiringly at his task as press secretary and with average success.

On Tuesday afternoon the Society travelled by bus to Wellesley, held a short session for papers, drank tea in the Whitin Observatory residence with Mr. and Mrs. and Miss Duncan, inspected the model laboratory and library, and, just after dark, took a look at Wilk's comet. One was reminded of the time two years ago when Duncan was measuring Skjellerup's comet while most of the rest of us were trying to catch a glimpse of it.

The Harvard Observatory was open to visitors in the early evening while the Council was hurrying through another business meeting in order to be on time for the party.

It would be difficult to describe this New Year's party adequately. During the search for a form of entertainment adapted to the number of guests, there came the happy recollection of the discovery of a manuscript years ago somewhere in the observatory library and the still more fortunate rediscovery of it somewhere else in the library.

Erudite research led to the conclusion that the manuscript, which was entitled "The Harvard Observatory Pinafore," was written by Winslow Upton in 1879, soon after E. C. Pickering became director of the observatory and at the time when he was devising and constructing one photometer after another and naming them with letters of the alphabet. Photometer P, which is missing from the sequence, was pictured as an especially refractory instrument, to which Mr. Upton was assigned on account of his physical prowess.

"I'll Stay Your Hand."

Discord and devious devices were engendered in the "right good crew" by the attempt of Dr. Leonard Waldo, whose lightest word was corroborated by the "influential Men of Providence," to induce Josephine, "the fairest flower that ever blossomed on scientific timber," to leave her position as assistant to Professor William A. Rogers. Eventually she finds that she cannot tear herself away from the meridian circle, which is to her "an object of passionate love." Dr. Waldo's disappointment seemed completely assuaged by the unexpected offer of one of the fair computers to go with him and hover about him in his years of declination.

Those who struggle with photometers sympathized with Pickering in his lament: "all my magnitudes are at sixes and sevens and now my prisms all rebel," and appreciative applause was given by the astronomer who did not need to be told that

> His knees should bend and his neck should curl,
> His back should twist and his face should scowl,
> One eye should squint and the other protrude,
> And this should be his customary attitude.

The method of selecting the cast, which consisted in listening at the dark-room door while the developer burst into song, proved eminently satisfactory. The voices were all as well suited to the stage as they were to the dark-room.

Between the first and second acts, Messrs. Andrews and Wheelwright presented a skit entitled "Heavy Business" in which Atlas kneels "on a cloud of interstellar calcium—soft but unsubstantial."

After the play and the refreshments, Mr. Schlesinger gave a timely lecture on the calendar. Community singing was then led and directed by Josephine and accompanied by the musical part of the Shapley family. As the ticking of the observatory clock, connected with a sounder in the room, warned the company of the approaching end of the Old Year, all stood at attention, Willis Harlow Shapley sounded taps, Mr. King sounded the bell, and everybody wished everybody else a Happy New Year. The party was a great success.

The Harvard Observatory staff made an equally good showing next morning in presenting a thousand and one variables. The group photograph was taken just before the afternoon session. All the bashful people were finally brought around from the back and made to stand in the front row.

At the close of the session, the secretary reviewed the actions of the Council:

Professor Friedrich Küstner of Bonn has been elected an honorary member.

The invitation tendered by Mr. Fox to hold the next meeting at the Adler Planetarium and Astronomical Museum has been accepted. The date of the meeting has not been arranged but it will probably be in September.

Messrs. Boss, Brown, and Peters, *chairman,* have been appointed a committee to consider the investment of the funds of the Society.

Messrs. Schlesinger and Dugan have been selected as delegates of the Society to the fiftieth anniversary of the founding of the American Society of Mechanical Engineers.

A committee composed of Messrs. Hammond, Milham, and Stebbins, *chairman,* which was appointed to define the sliding scale of life membership fees provided for by the new constitution, has made a report which will be distributed with the call for the next meeting as a proposed revision of the by-laws.

The President was authorized to appoint a committee to proceed with the organization of the meeting of the International Astronomical Union in this country in 1932.

A committee of five to consider whether it is advisable that the Society should undertake the publication of a journal was likewise authorized.

The Council decided to offer an exchange of information concerning vacancies and applicants in astronomy and asked Mr. Dugan to undertake this service.

The nominating committee, elected at the last meeting and composed of Miss Furness, *chairman*, Messrs. Curtis and Littell, availing themselves of the permission to nominate two candidates for each vacancy, presented the following ballot for the next election. This was approved by the Council.

For Vice President	1930-32	W. S. Eichelberger
		Joel Stebbins
Secretary	1930-31	Sebastian Albrecht
		R. S. Dugan
Treasurer	1930-31	Benjamin Boss
		W. I. Milham
Councilors	1930-33	J. C. Hammond
		E. P. Hubble
		C. P. Olivier
		Cecilia N. Payne
		R. M. Stewart
		R. E. Wilson
	1930-32	Keivin Burns
		A. E. Douglass
	1930-31	Frederick Slocum
		R. H. Tucker

Member of the Division of Physical Sciences, National Research Council:

1931-34 H. N. Russell, C. E. St. John.

The following nineteen new members have been elected. The total membership is now 498.

John Allen, University of Minnesota, Minneapolis, Minnesota.
O. F. H. Bert, Washington and Jefferson College, Washington, Pennsylvania.
Wm. Malcolm Browne, U. S. Naval Observatory, Washington, D. C.
Edgar N. Fought, 6630 Woodland Avenue, Philadelphia, Pennsylvania.
Richard Halsey Goddard, Dartmouth College, Hanover, New Hampshire.
Leon Hufnagel, Harvard College Observatory, Cambridge, Massachusetts.
Philip C. Keenan, Steward Observatory, Tucson, Arizona.
Alfred L. Loomis, Tuxedo Park, New York.
William A. Luby, Junior College of Kansas City, Kansas City, Missouri.
Roy K. Marshall, Detroit Observatory, Ann Arbor, Michigan.
Peter M. Millman, Harvard College Observatory, Cambridge, Massachusetts.
John Dewey Phenix, U. S. Naval Observatory, Washington, D. C.
Helen M. Porter, Mt. Holyoke College, South Hadley, Massachusetts.
J. Hugh Pruett, P. O. Box 185, Eugene, Oregon.
Bevan P. Sharpless, U. S. Naval Observatory, Washington, D. C.
Ernest Whitworth, Sproul Observatory, Swarthmore, Pennsylvania.
Robert I. Wolff, College of the City of New York, New York City.
R. v. d. R. Woolley, Mt. Wilson Observatory, Pasadena, California.
Richard S. Zug, Yerkes Observatory, Williams Bay, Wisconsin.

Following this report, Mr. Curtis offered a resolution of thanks and appreciation to all those who had made the meeting so enjoyable and so successful.

After the adjournment of the meeting, the members went to the Commander Hotel where they were formally introduced to some of the

local members in the guise of officials of the Bond Astronomical Club and more tea was imbibed.

The dinner in the evening at the Commander was the usual relaxation for everyone except the speakers—Miss Farnsworth, representing the A.A.V.S.O.; Mr. H. H. Plaskett, representing the press; and Mr. S. A. Mitchell, the farthest from home. The President, as toastmaster, seized the opportunity to make several speeches. The Pinafore cast consented to give several encores and everyone joined in the choruses directed by the magic wand of Josephine. The singing closed with the following verse which had been distributed by stealth:

> Let's give three cheers for Ernest Brown
> Who brings the astronomers to our town.
> He comes too late and he goes too soon,
> And he chases the stars behind the Moon.

The meeting ended with a trip on Thursday morning to the General Electric plant in West Lynn. Dr. Elihu Thomson and his colleagues had prepared an exhibit of their work on quartz mirrors, from the mined quartz to the finished mirror. After examining this exhibit and being conducted through the laboratory the members came away with the feeling that the realization of the 200-inch mirror was now simply a matter of detail.

The following members were present:

Miss Allen
Miss Ames
Andrews
Arnold
Bacon
Bailey
Miss Barney
Barton
Bert
Miss Bigelow
Mrs. B. J. Bok
Boothroyd
Brigham
E. W. Brown
L. Campbell
Miss Cannon
Currier
Curtis
Daghlian
Douglass
Dugan
Duncan
Eckert
Eichelberger
Miss Farnsworth
Fecker
Clyde Fisher
W. J. Fisher
Miss France
Miss Furness
Geromanos
Gerrish
Miss Gesler
Miss Glancy
Green
Miss Gushee
Hammond
Miss Harwood
Miss Hawes
Hufnagel
Hujer
Ingalls
M. F. Jordan
E. S. King
Kovalenko
Littell
Lundin
Lundmark
Manson
Marriott
Miss Maury
Mrs. R. N. Mayall
McNally
Mees
J. E. Merrill
Milham
J. A. Miller
Millman
Mitchell
Pawling
Miss Payne
D. B. Pickering
Pitman
H. H. Plaskett
Pogo
Miss Porter
Putnam
Robertson
Robinson
Rogers
Miss Sawyer
Schilt
Schlesinger
Shapley
Slocum
Stearns
J. Q. Stewart
R. M. Stewart
Stokley
Storer
Miss Swartz
Miss Swope
Thomson
Van Arnam
van de Kamp
R. L. Waterfield
Whitworth
Miss Marjorie Williams
Willis
Mrs. Wills
Miss Anne S. Young

Those present as guests included:

Miss C. J. Anger	L. M. Lindsay	E. W. Pike
B. J. Bok	N. C. Little	W. R. Ransom
Miss A. Cunningham	Mrs. Lundin	Mrs. Robinson
Mrs. Dugan	Miss R. Lundin	S. Rosseland
Mrs. Duncan	D. W. Mann	A. R. Sayer
Miss Duncan	Miss S. F. Marden	Mrs. Schlesinger
Miss M. R. Dwyer	Miss G. Maulbetsch	Mrs. Shapley
Mrs. C. Essenberg	Mrs. J. E. Merrill	C. C. Sherman
Mrs. Fecker	Mrs. Milham	Mrs. Slocum
Miss E. W. Grieve	F. D. Miller	Miss K. Sweet
J. S. Hall	Mrs. J. A. Miller	Mrs. W. Upton
Mrs. Hammond	Miss J. Mohr	Miss A. Walker
Miss L. L. Hodgdon	R. M. Motherwell	G. W. Wheelwright
Miss E. D. Hoffleit	B. V. Numerov	H. R. Willard
Mrs. Hujer	Miss M. Olmsted	Mrs. Willis
Mrs. E. S. King	J. Pelseneer	Miss I. E. Woods
Mrs. Kovalenko	Mrs. D. B. Pickering	Miss E. A. Young

[*To be continued.*]

AN AMATEUR'S OBSERVATORY

By DAVID B. PICKERING.

Fifteen or twenty years ago the amateur telescopist felt the need of an enclosed observatory much less than he does today. More than likely, as is often the case today, he would have been quite alone in the pursuit of his hobby—a rather sad object to his friends and neighbors, who secretly surmised that he might be a little bit cracked. As he lugged his clumsy tripod out of doors in the early evening and adjusted the tube to the mounting, passersby would look upon him with feelings of mingled curiosity and pity. But if the night promised to be fine, and the objects which had fired his imagination throughout the long day now ending were soon to be within the reach of his "optic tube," what cared he for passersby or their mundane speculations? He was a pioneer blazing trails through space, and the glow in his heart made him all unconscious of nearby, familiar things.

Like many another of that day, about to begin his observational experience, I had never met any one who had ever looked through a telescope. There had been years of observing with various small instruments that gradually progressed from a draw-tube affair of 1¼ inches to a fine 3½-inch Burns. In time, as inevitably happens, the labor of carrying the rather heavy tube and tripod of the latter instrument out into the open; of assembling the parts; of preparing a windshield to protect charts and atlas; of procuring and adjusting a lamp, and other numerous feats costing time and labor, created the desire for a permanent housing.

At the time of planning and building the dome on my residence, as here illustrated, I had never seen an amateur's observatory. The details

of construction evolved in my mind as I lay in bed each night waiting for sleep. Finally I stepped around the corner of the street and found a local carpenter who didn't know whether a telescope was an animal or a disease, and together we worked the thing out.

This was in the spring of 1916.

Crude as it now seems in many ways, it has never failed me. It worked then and it works now. Despite its card-board and canvas construction, never a drop of moisture has penetrated the dome in all these years. The wooden pier, resting upon the house beams, has never thrown the mounting out of adjustment, nor communicated a tremor which was perceptible in the ocular.

Mr. Pickering's Observatory on Roof of House.

On the third floor of the house are wooden stairs, hinged to the ceiling, which, when not in use are drawn overhead by rope and pulley. These lead through the roof to a trap-door in the floor of the observing room. This room, having windows north and south, is eight feet square and seven feet high to the base of the dome. Convenient racks for charts, lens boxes, and other accessories are arranged between the wall beams, while triangular table-tops in the corners can be used at two different heights, or laid aside.

Electric light wires enter at two sides of the room for lighting the tables, while a third wire emerges from the central pillar, about a foot from the top, for convenience in reading the circles. This latter operation is further facilitated by the use of a pair of circular steps which surround the base of the pillar. The latter is constructed of well sea-

soned wood, built up of longitudinal sections to prevent warping. It is eight inches in diameter and rises six feet above the floor. It rests on cross beams that run below the roof of the house and are fastened to the side cross ties of the same. Being thus perfectly free from contact with the floor of the observing room, the pier communicates no vibration to the telescope except that emanating from the main building.

Mineral wool is packed about the base of the pier to prevent the annoyance from such heat waves as might arise from the house. The dome, which weighs 250 lbs., is covered with ⅜-inch composition board, under a layer of canvas. It is built with 16 ribs, converging toward the top and meeting the frame of the shutter slit, which is 18 inches wide, and extends ten inches beyond the zenith point. All of the material in ribs and slit border is white pine, 3 inches by ⅞-inch, mill turned. The ribs fasten to a base of oak, about 3 inches by 4 inches, built up of sections of boards superimposed upon their flat sides, mill turned to the desired arc and overlapping. Into this base are countersunk the cases of 12 two-inch grooved steel ball-bearing wheels, which run upon a metal T-shaped track fastened to a bed of solid 4-inch by 4-inch oak, turned to correspond with the base of the dome. Iron flanges, fastened to this bed, run in a groove in the base of the dome, to prevent dislodgment in a heavy wind. A heavy, knotted rope, hanging from one of the ribs opposite the slit opening, enables one to turn the dome at will, though not so easily as in cases of more modern construction, where much justifiable consideration is given to the elimination of friction.

There are two sliding shutters; the upper of 4 feet and the lower of 3 feet of arc running on concealed metal rollers and held in place by pins that slide in grooves cut on the inside of the raised 3-inch by 1-inch pine tracks on which they operate. These are easily manipulated by a simple system of ropes and pulleys.

The interior of both dome and room is painted a flat black; the exterior, to match the building.

The equatorial mounting is secured to the top of the pier by three double nut bolts, which admit of adjustment in all positions. The horizontal telescope tube rests 7 feet 6 inches above the floor, greatly facilitating zenith observation.

The 3½-inch Burns, was the glass originally installed, and a mounting by Mogey gave me my first circles. Later, a larger mounting was demanded to accommodate the old 5-inch Draper telescope, which I had borrowed from the Harvard College Observatory, and employed for some years in the observation of variable stars. The focal length of this staunch old instrument, with its battered tin tube, was 84 inches, and the fact that I could not insert my head between the eyepiece and the base of the dome—there being but six inches to spare—led me to the use of a diagonal, which I now prefer in any case.

Later, this old friend was shipped back to Cambridge, on the acquisition of the present incumbent of the dome. The new comer, however,

should be entitled to about the same respect for age, for it was built by one Towne, during civil war times, and has a conical wooden tube. Though having the same 5-inch aperture as its predecessor, this instrument is a dwarf where the Draper was a giant. Its focal length is but 34 inches. Both optically and mechanically it is beautifully made and gives a large, bright field, splendidly suited to variable star observing. Its shortness enables one to observe in all positions with almost the ease of that in using a reflector.

Conceding the great conveniences that a dome offers the observer, both in the saving of time and the facility of operation, there is one glorious feature which, perforce, it excludes. Here, indeed, he is protected from the wind and the city lights; here, at his hand, are all the materials he requires; he begins his work promptly and with no exertion; his clock tells him sidereal time; his hour angles are soon determined; his circles train the glass upon the star; the dome revolves into position. But something is missing—a big something. Something that the professional astronomer has missed for so long that perhaps he has almost forgotten it. Above one's head the stars have been blotted out. A black pall has been spread between him and that star-lit canopy. The familiar and loved constellations are gone.

Oh yes, one can do more and better work under a dome. But ever dearer becomes the memory of the old free-lance nights "out in the open."

Trouble, inconvenience, fuss—but how inconsequential these become, when in the stillness of the small hours you stand on the threshold of Infinity and return the friendly glances of the thousand suns that smile down upon you. There, in the south, the tail of Scorpio just touches the horizon—Antares gives you a neighborly nod—the broad Milky Way glows with gobs of gold through Sagittarius and Ophiuchus.

Oh yes,—you must have a dome.

But let me conjure all who may be contemplating the study of astronomy: *Begin in the open.*

THE METEOR

Down thru the cold blue depths you've gone
A wanderer lone
Bearing a message written on
Metallic stone.
Cast from the planet of your birth
Thru cold you've flown,
Cold such as mortals on the earth
Have never known.
Heat you have found in wintry skies
Earth's atmosphere
Set you aflame, to many eyes
An omen drear.
Lucky the ones who, searching, read
Your message true.
Wanderer of the lightning speed
Down from the blue.

3512 Kyle, Robbinsdale, Minnesota. IMOGEN DORMAN.

REFLECTORS VERSUS REFRACTORS

By WILLIAM H. PICKERING.

Having experimented with reflectors now for four years, and having been familiar with refractors for over forty, the writer has arrived at certain conclusions that may possibly interest some professional astronomers, and which he thinks should be of use to some amateurs. There are now but two kinds of astronomical investigation that are really worth while open to possessors of small or medium sized telescopes, whether they are professionals or amateurs. For those having small telescopes, those of 5 inches aperture or less, there is only one,—the observation of long-period variable stars. For those possessing telescopes of larger aperture, we will say from 8 to 15 inches, the fascinating field of planetary research is also open, provided their climate is a satisfactory one. Telescopes of 5 to 8 inches aperture can also occasionally be used to advantage for such investigations. This class of work, however, requires good seeing, and it is therefore difficult to do much that is useful with any telescope in our northern states. This necessity of working in a comparatively low latitude, when good definition is required, has now I believe at last become generally recognized by astronomers. The *main* reason why a low latitude is desirable is in order that we may avoid the atmospheric circulation of the anticyclones. But even in hot summer weather the seeing in the north is seldom satisfactory, though not so bad as in winter. Secondly, in summer, even when the seeing is fair, then is the time when all the planets are nearest the southern horizon at opposition, that is when they are nearest to us. This is because the ecliptic is farthest south at that time. The importance of this reason is particularly marked in the case of the planet Mars, on account of the striking changes that occur upon its surface at the favorable apparitions occurring in June and July, and to a less extent in August when it is still near us. Thirdly, although of less consequence than the other two, at all times the planets are seen at higher altitudes in southern stations. I have found that even some professional astronomers thought that this was the chief advantage of going south to observe. In reality it counts for very little as far as America is concerned. It is doubtful unfortunately if very much valuable planetary work can be done north of the Ohio river.

Oddly enough, on the other side of the Atlantic, they often have excellent seeing in the British Isles, when they can see anything at all through the clouds. This fact is well illustrated by their early discovery of a dozen of the Martian canals long before Schiaparelli ever looked at the planet, their well-known British modesty having prevented them from ever acknowledging the fact. They accordingly waited for an American to find it out. Thus Procter's map, based on Dawe's draw-

ings of the apparition of 1864 shows the following canals: Hydraotes, Nectar, Agathodaemon, Sirenius, Brontes, Erebus, Styx, Cerberus, Eunostos, Nepenthes, Nilosyrtis, and Protonilus. The last two, however, together with Nasamon, were discovered by Sir John Herschel in 1830, and some of the others by Lockyer, Lassell, and others. Secchi at Rome in 1858 discovered Ganges, which gives the Italians an early claim, although no priority. Beer and Maedler mapped Nectar and Agathodaemon in 1840. I do not say this of course to disparage the work of Schiaparelli, which needs no support from me, but merely to state a fact illustrating my statement that they sometimes have good seeing in the British Isles. The explanation of this is doubtless because of their moist climate, which we now know favors good seeing. Thus on fifteen nights of comparatively poor seeing in Jamaica in the years 1914, '15, and '16, the mean dewfall averaged 3.6 cubic centimeters per square meter of horizontal surface of blackened iron. On thirteen nights of practically perfect seeing the dewfall averaged 108.1 cubic centimeters, or just thirty times as much. (*H.A.*, **82**, 37.) Indeed, whenever we have a calm clear night with heavy dewfall, the seeing is invariably practically perfect. On the continent of Europe the seeing appears to vary with the latitude much as it does in the States. We gather all these results in part from our own experience of over twenty years in the torrid zone, and in part from the numerous drawings of Mars that have been sent to us from all over the world during the past fifteen years.

An Inexpensive Mounting and Shelter.

Turning now to the instrument, if one has to buy it, there is no question but that the amateur of moderate means will get more for his money with a reflector than with a refractor. If he can make it himself, he will obviously make a reflector. On the other hand if the observer is located in a southern latitude, has good eyes and enthusiasm, and can afford it, a refractor of the same aperture as a reflector, and costing three or four times as much, will show far more fine detail on the Moon and planets. It will of course require a fifty per cent larger dome, or shelter, also adding to the expense. The amateur's reflector rarely exceeds 12 or 13 inches in aperture, and about 10 feet in focal length. For planetary research it is not worth while to buy a refractor whose aperture is less than 7 or 8 inches, since one can do nearly as well with a reflector costing less money. The only forms of reflector in use at the present day are the Cassegrain and the Newtonian. On account of the difficulty of grinding the hyperbolic mirror, the former is used only for large telescopes. Another objection to this form, at least for studying planetary detail, is that the comparatively large size of this mirror, usually about ⅓ or ¼ that of the parabolic one, causes extensive diffraction rings, or if the rings are not visible as such, an equivalent amount of scattered light, which is unavoidable. Even with a ratio of ¼ the equivalent focus is likely to be exceptionally long, unless the focus of the

parabolic mirror is quite short. This again involves difficulties of grinding. Practically all small reflectors therefore are of the Newtonian type. The very great inconvenience of this form when the focal length approaches ten feet is that the observer's eye has to be at the top of the tube, instead of at the bottom, as in a refractor. Moreover, in order to observe an object south of the zenith, the best place in the whole sky for studying planetary detail, it is necessary to make use of a movable wooden bridge. Moving about in the dark on a rather shaky platform four or five feet above the ground, if persisted in, may result in a rather disagreeable fall. The writer always illumines his bridge by an elevated electric light giving about twice the light of the full moon.

In order to avoid this defect of the Newtonian reflector, a device was proposed and constructed three years ago called the Springfield mounting. It is fully described in *The Scientific American,* 1926, 166, also in a book issued by that magazine. By means of a curious cannon ball counterpoise, and a third mirror, the observer is enabled to sit in one position and look down the polar axis of the tube at an object in any portion of the sky. The third mirror is objectionable in three ways. In the first place unless kept freshly silvered, it reduces whatever light the first two mirrors reflect by one-half. In the second place it turns all objects right for left, and in the third, when looking down a tube at an angle of 40° to 50° considerable trouble will be caused, at least for planetary observers, by floating motes within the eye itself. To avoid these objections the writer described a form of Newtonian reflector involving only two mirrors, and involving no change of position, except when the object transits the meridian. The observer must then move within an hour or so from a comfortable seat on one side of the pier to a similar one on the other side. Moreover he always looks nearly horizontally into the telescope, thus to a considerable extent avoiding the moving specks within the eye. It is only when looking at an object in the far north which is at the same time far from the meridian that he needs to look up or down at a considerable angle. This is in fact the only form of reflector of any kind using but two mirrors and permitting a comfortable stationary seat. Moreover it makes use of a fork-mounting, so that the telescope never has to be reversed. This is of especial advantage to planetary observers, and to those who wish to photograph objects near the meridian with long exposures. As in all mechanical devices where considerable advantages are secured, there must be some sacrifices. The chief one is that the tube must be about half as long again as in the ordinary form of Newtonian, in order that the single counterpoise may not be more than twice as heavy as the mirror. The second disadvantage is that there is a region surrounding the north pole with a radius of at least 20°, but not exceeding 30°, which cannot be observed at all. In the latter case we lose one-fifteenth of the northern heavens. It is a very uninteresting region, however, its southern boundary passing between the five well-known stars of Cassiopeia and the two pointers of the Dipper. This obviously does not trouble planetary

observers, and this form of mounting has the somewhat compensating advantage that it can probably be constructed more cheaply than any other equatorial form hitherto proposed.

It is fully described in POPULAR ASTRONOMY, 1926, **34**, 570, the accompanying schematical drawing being repeated in Figure 1. A further great advantage of this form of reflector is that it is not necessary to revolve the mirror or the tube at all, but only a light inner tube carrying the flat. On account of the distance of the counterpoise as at present arranged, this is now done by means of a short slot in the outer tube

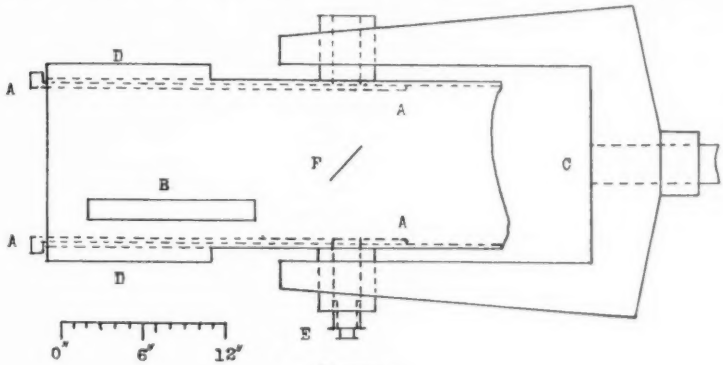


FIGURE 1.

shown at *A* in Figure 2. A pin which can be passed through this slot enters one of a series of holes in the inner tube permitting it to be turned, so that the observer may look through either end of the declination axis as is desired. In Figure 2 the telescope is shown as stored in a tent-shaped shelter in the form of an equilateral prism. This shelter may consist of a wooden framework covered with wire netting and canvas, or with sheet zinc. It rolls away to the north over an iron track, the wheels on one side being grooved to fit the rail, and on the other side rolling on a flat surface, thus avoiding all danger of binding. A door 2.5 feet wide and 10.5 feet high in the southern end of the prism permits this motion. There can of course be no threshold, and no floor frame south of *B*. A removable brace could however be put in if desired, but none is found necessary here where a similar arrangement has been in use for the past fifteen years. The observer sits on a high chair whose seat is 7 to 7.5 feet from the ground. A flat box 5 inches thick which may be placed on the seat will permit of adjusting the body to observe objects when the eye is above the level of the intersection of the axes.*

*Should anyone care to construct a telescope of this form, the writer would be very glad to hear of his success,—also of his difficulties.

The Question of Air Currents in the Tube.

The reason why a reflector for the same aperture is inferior to a refractor is at least three-fold. In the first place there are very effective air currents of varying temperature in the tube of a reflector, that is to say if the tube is solid or covered, and all small reflectors on the market at present have solid tubes, that is continuous metal or wooden tubes, as distinguished from those which consist of an open lattice work of metal. All the large modern reflectors on the other hand have lattice work tubes. They also are all mounted inside of domes, which is frequently not the case with small reflectors, which are often used in the open air

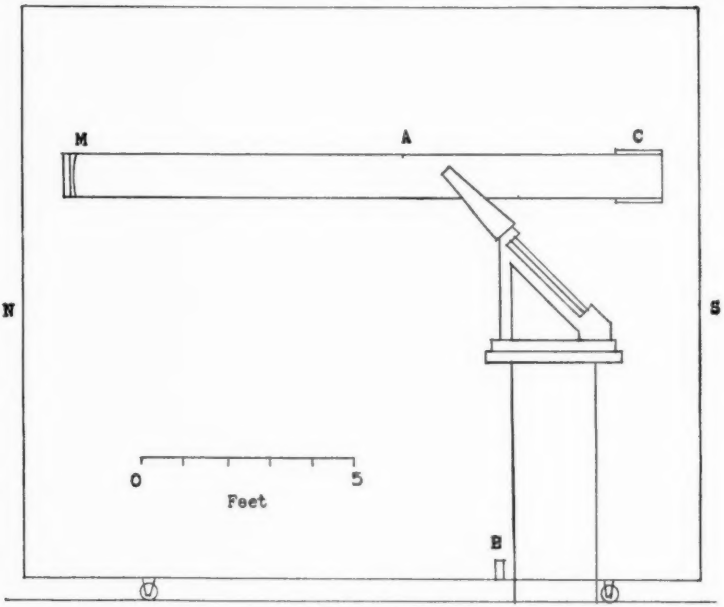


Figure 2.

with a hinged shelter, or one rolling away on a track. There appears to be a considerable divergence of opinion among the users of these latter as to the best form of tube. It is evidently a matter of very great importance, but does not appear to have been discussed in print heretofore. Dr. F. O. B. Ellison writes from Ceylon that while in Egypt he "tried both open and covered tubes, and found that the open was the better there," but later in Ceylon in a moister climate he writes "I have taken your advice about covering the whole of my telescope tube and find a great improvement in definition resulting." L. J. Wilson has the two ends of his tube covered, in order to keep the dew from forming on his mirror and flat. The middle section is open, but he says he gets better

results if it is covered with paper. He thinks that the paper protects the air in the tube from the warmth of his body. G. H. Hamilton's tube is similarly arranged, but he prefers an open middle section. Of course the temperature at night, which never falls below 60° in Jamaica, is higher than in Kentucky, and it is possible that this may in part explain their divergent opinions. However, Ellison preferred a covered tube in a warm climate, while in Egypt, where he preferred an open one, the nights are cold, at least in winter. Messrs. Phillips, Hargreaves, and Peck used an 18-inch mirror, at first in a solid wooden tube. On substituting an open one for it they found a very striking improvement, Hargreaves even going so far as to write, "The performance of the 18-inch in its skeleton tube has caused us to revise our views on the reflector versus the refractor question. In a skeleton tube we are convinced that a mirror gives at least as steady an image as an object glass." This appears to me to be a rather extreme view, if by steady is meant as clear an image, and while it might be true with what we should call moderate seeing in Jamaica, I am very sure it would not hold when the seeing is really good.

We all know when first starting a furnace in the autumn, that the hot air does not at once pour out of the flue, but is for a time blocked by the cold air already there, and which floats on top of the hotter lighter medium, later gradually mixing with it, and finally being forced out into the room. If we could look through those mixing masses of air in the tube, we should find the seeing intolerable. It occurred to me while using my reflector that that was just what was occurring within the iron tube of my telescope. When the shelter is rolled away, and the instrument is exposed to the outside air, the upper end of the tube is cooled by radiation to the sky, while the lower end, not so completely exposed, retains some of its original warmth. We accordingly have within the tube a mass of cold air resting upon a mass of warmer material. Since the quality of the seeing is not influenced by the velocity of the air currents, whether within the tube or in the sky, no matter how high that velocity may be, but is strongly influenced by the least difference of temperature, I determined to go to the bottom of the matter and collect the fundamental facts. I therefore procured three ordinary thermometers, and after comparing them side by side, I hung one with its bulb about four inches below the flat, and another so that when the tube was vertical the bulb was just over the mirror. The third thermometer was placed under the wooden bridge close at hand. The middle section of my iron tube was always sheathed with wood. The lower section was never sheathed, and the window near the mirror was always left open, in order to give as good a circulation as possible. A thin blackened tube of pressed wood fiber was fitted just inside of the telescope tube, extending down as far as the flat. Its object was to cut off radiation from the inside of the tube.

In four series of observations the upper section was left unsheathed. In four other series it was sheathed with asbestos, and in seven more it

was sheathed with wood. The first observation of each series was made immediately after opening the telescope for the night, usually between 6:00 and 9:00 o'clock, the last was made about two hours later. The fifteen series were made on fourteen nights, between January 22, 23, and March 4, 5, of 1927. The average temperature under the bridge at the beginning of the observations was 68°.0, and at the end 65°.1. The temperature at the bottom of the tube was nearly always higher than it was under the bridge, or at the top of the tube. The average difference of temperature between the two ends of the tube in the four cases where the upper end was unsheathed, at the beginning of the observations was $+1°.1 \pm 0°.3$, and at the end $+1°.5 \pm 0°.4$. In the four cases where it was sheathed with asbestos the difference at the beginning was $+1°.7 \pm 0°.3$, and at the end $+1°.5 \pm 0°.8$. In the seven cases where it was sheathed with wood the difference at the beginning was $+0°.8 \pm 0°.7$, and at the end $+1°.1 \pm 0°.7$. Three conclusions were arrived at, first that sheathing the upper end of the tube with asbestos was worse than leaving it unsheathed. This was apparently due to the asbestos collecting moisture from the atmosphere and actually becoming wet. Second that sheathing the upper section with wood was an improvement, and third that, although the temperature at both ends of the tube fell as the evening wore on, that at the top of the tube fell faster, thus gradually increasing the difference in their temperatures.

The obvious remedy to employ is to use an electric fan, forcing a current of air from the window near the mirror up through the tube. Care must be taken to support the fan in such a manner that it shall not jar the telescope. A 6-inch fan is plenty large enough. With poor seeing, due mainly to currents in the upper air, the improvement resulting is not marked, but with good seeing it is most striking. It is very nicely illustrated by throwing a bright star out of focus before turning on the fan. The image usually rotates, sometimes in one direction, sometimes in the other. The rings always visible in such an image constantly vary in shape, with an appearance that we may describe as "moulding." The instant the fan is turned on all is instantly changed, the rings become circular, and all rotation ceases. Mr. Phillips in a recent paper speaks of having tried an "electric blower" but does not seem to have been quite satisfied with the result, because trouble began "as soon as the blower is stopped." (*Journ. Brit. Astron. Assoc.*, 1929, **39**, 113.) In my original paper describing the use of a fan, Report on Mars No. **41**, I state that an "electric fan sending a current of air through the window near the mirror, and up through the tube, was later found to give greatly improved results." (POPULAR ASTRONOMY, 1928, **36**, 451.) It did not at that time seem necessary to me to state that the fan should be kept going. In order to avoid jar I always support it on a cushion.

Since the opinions as to the relative advantages of open versus closed tubes are so divergent, it appears to me likely that with neither form are the mixing air masses entirely avoided, and that each observer should

settle which is the best form for his own individual case. However, when an electric current is available, I feel that a closed tube with a fan entirely avoids the whole difficulty, and is therefore better than any open tube can be. Indeed in my recent Report on Mars No. 43 I recommended a similar arrangement to be tried on all large refractors. In such a case the best plan would perhaps be to employ a blower in place of a fan, and either suck or drive the air out of the tube. As a result of this investigation it now appears plausible to believe that the reason why a large refractor shows little if any finer planetary detail than one of moderate size is, not as I formerly suggested, that with a larger diameter it takes in more atmospheric waves, blurring the image, but that it is simply a question not of diameter, but of length. Reducing the diameter of the lens by a diaphragm up to a certain point undoubtedly improves the definition, but this is because the effect of the cold air currents moving down the sides of the tube is cut off by the diaphragm, leaving only the warm upward currents near the center of the tube. It appears probable that for either a reflector or a refractor better seeing would be obtained, in a good climate, if the diameter of the tube was appreciably larger than the diameter of the mirror or lens. In case a fan is not available, a wooden tube is better than one of metal. For a large refractor with a long tube, there is a greater range of temperature of the air within it, and a longer column of mixing air of different temperatures than with a smaller one. By blowing or sucking out this air, there will be a constant current of uniform temperature passing through the tube, giving greatly improved definition. As long as the air is of uniform temperature, the speed of the current makes no difference as far as the seeing is concerned. In the case of the Lick telescope, one rather wonders what might be seen on Mars on a really good night, if the air within the tube were kept at a uniform temperature. It might give us rather startling information. It would seem almost a duty to try it.

The Diffraction Rings.

A really good refractor of any size up to 12 to 15 inches aperture, with really good seeing, and a ¼-inch eyepiece, should show a bright star as a round perfectly uniform disk, surrounded by two or three fainter complete rings, which with the best seeing will be stationary or nearly so. I was once at a meeting many years ago, of the American Astronomical Society, where were present at least twenty or thirty professional astronomers, and someone asked the question if anyone present had ever seen a star disk surrounded by rings. To my very great astonishment only one or two others besides myself admitted that they had ever seen the appearance. With a ½-inch eyepiece and good seeing I have seen as many as a dozen rings about a really bright star such as Arcturus, with a 12-inch refractor, but it requires much better seeing to see two or three nearly stationary rings with a ¼-inch. Anyone can see the rings with an ordinary spyglass by cutting down the aperture to about 1/12 of the focal length, and using a high power eyepiece. With

so small an aperture the rings will of course be faint. I have never seen the rings with any reflector using the full aperture, but with my 12-inch Calver stopped down to 5.5 inches, or about 1/20 the focal length, I have seen portions of them surrounding the central disk. This is probably the best that it will do while with the Harvard 11-inch refractor complete rings were by no means an unusual phenomenon. This shows at once that even as good an optician as Calver could not grind a mirror that would give definition at all comparable even to an early Clark refractor.

A much more important cause of the inferiority of the reflector depends on the brightness of the diffraction arcs. These vary in width and brilliancy with the seeing. They are never narrower than the spaces between the successive arcs, and may be 1.5 times as wide. When the seeing was good I have seen the arcs only half as wide as the diameter of the disk, but when it is bad, the arcs then shorten to rounded dots which are practically of the same size and brightness as the disk itself, and on account of their rapid motion are often indistinguishable from it. These observations were all made with my mirror stopped down to 8 or to 5.5 inches, giving a ratio to the focus of 1/14 to 1/21. A bright star was always selected, usually Vega. With a 3-inch refractor, whose ratio of aperture to focus was 1/13, the rings were 0.7 as wide as the spaces between them, and 0.25 the diameter of the disk. We may say in general that the rings with a refractor are but one-half as wide as those given with a reflector. The important difference between the two classes of telescopes, however, lies not in the width, but in the relative brightness of the arcs and disk. With the reflector I have seen the brightness of the arcs no greater than that of the disk, but when the seeing deteriorates it is often 3 or even 5 times as great. In such a case the effective diameter of the combined blur of light may be 5 times the diameter of the disk. With the refractor, with good seeing, the combined light of all the arcs or rings ranges from about 0.05 to 0.10 that of the disk.

This astonishing difference between the two instruments it appears is not due to any fault of the mirror, but to the little considered, but most injurious flat. If we place a round paper disk somewhat larger than the flat outside of it, the arcs at once increase in number and conspicuousness. On the other hand if we place a small eccentric diaphragm over the end of the telescope so that the light transmitted by it does not strike the flat or its supports, but proceeds directly to the mirror, the seeing at once appears to improve, the arcs fade out, and the general appearance is that of a star as seen in a refractor. This plan has already been adopted by Professor Douglass with his 36-inch mirror in his studies of Mars. By employing a 13-inch eccentric diaphragm, his results are comparable to those of a 13-inch refractor, and, as is seen by Report on Mars No. **43**, as far as confirmed canals are concerned he ranks next to Trumpler. When a refractor is pointed on Mars, the image formed at the focus consists of a great number of minute disks

of varying brilliancy, each one being of the size of a stellar disk. Over these is superposed a thin veil composed of the combined faint images of the diffraction rings. On the other hand in the case of a reflector, the image consists of a series of overlapping splotches of light of the effective diameter of a stellar disk and the surrounding arcs combined. It is no wonder then that with good seeing a reflector gives inferior results to a refractor. The only surprise is that it should give as good results as it does.

The reason why the 100-inch on Mount Wilson shows such good planetary definition is probably that with so large an aperture, the combined disk and arcs are so small as to be comparable to the stellar disk alone of a much smaller refractor. It is quite possible that even for planetary work, a refractor of the highest grade is not usually necessary. For instance, no 12-inch refractor is conceivable which would give such large stellar images as a 12-inch reflector, and of course such a refractor is always better, and would doubtless be better even if it were a pretty poor specimen of its kind. It is only in localities where the seeing is of the best, and perhaps for large refractors where the internal cold air currents are destroyed, that the advantages of a really first class objective should become manifest. In closing this portion of our paper, it may be said that we find that there are two important reasons why a reflector is inferior to a refractor of the same aperture. First, on account of the cold air currents in the tube of the reflector, and second, on account of the bright diffraction arcs due to the flat.

There is one important point that should be mentioned in this place. Many years ago, when I did more stellar astronomy than at present, I made a brief study of the diameters of star disks and rings. (*H.A.*, **61**, 43.) I was then struck by the fact that when the focus was long in proportion to the aperture, in a ratio of perhaps 1/100, the image of the star resembled its theoretical shape, with a hazy disk much brighter at the center than at the edges, and comparatively faint rings. With an ordinary telescope and good seeing, as is well known, the disk is uniformly bright, and the inner ring only slightly less bright intrinsically than the disk itself. A year ago I took the matter up again. The focus of my reflector as above stated is 113 inches, that of my finder 12. I stopped both down to a one-inch aperture, the magnification of the reflector being 50, and that of the finder 40. I turned on Capella and two diffraction rings came out nicely in the finder, and I could just see the third. With the reflector one ring came out faintly, but the disk was still bright, though perceptibly less so than in the finder. I then reduced the aperture of the finder to 0.6 inches. The first ring with the two instruments was then equally bright, no other rings were visible, but the star disk was much fainter in the finder. This experiment clearly indicated that the rings were much brighter in proportion to the disk with the shorter focused instrument. Whether this matter has been discussed theoretically I am not aware, and have no means here of finding out, but every astronomer who has seen the disk and rings knows that in an

ordinary refracting telescope, with a ratio of aperture to focus of 1/16, the edges of the disk are much brighter than the theory as applied to minute apertures demands, and these observations indicate that the same is true of the rings. The $20,000,000 16-foot mirror of the California Institute of Technology is to have a ratio of its aperture to its focus of only 1/3. Such an aperture can hardly show rings, perhaps not even rings of dots under terrestrial conditions of seeing, but it is very certain that every bright star image will be surrounded by an exceedingly brilliant blur, due to diffraction, and far exceeding the size and brightness of the stellar disk itself. It is highly probable that a somewhat smaller mirror of longer focus, and therefore easier to construct, and much cheaper, but requiring a more expensive dome or shelter, would give finer definition, but for direct photographs of remote nebulae, and spectroscopic work, where definition such as we require on the planets, if of little consequence, doubtless the present proportions will give satisfactory results. It appears very doubtful if it will give any better definition than the present 100-inch, but it will perhaps release that instrument for more planetary work should it prove on further tests to give better results than less expensive refractors. On the two nights on which I tried it on known delicate lunar detail it impressed me favorably, particularly as I was told that the seeing was then only of average quality.

PRIVATE OBSERVATORY, MANDEVILLE, JAMAICA, B. W. I., SEPTEMBER 18, 1929.

RUSSIAN OBSERVATORIES

By PAUL DAVIDOVICH.

On my return from the United States to Russia I had a chance to spend a part of last summer in the Tashkent Observatory where I began my astronomical work some twelve years ago.

Tashkent is located some twenty-one hundred miles southeast from Moscow (Lat. $+41^\circ\ 20'$, Long. $4^h\ 37^m$ east from Greenwich) which distance is covered by a through train in four days. There is a sleeper and dining car service, but not too much speed. The schedule is about sixty per cent slower than in the United States, but aside from this the traveller gets non-scheduled features. On the way there the train was late by four hours, and on the way back we were late in Moscow by 11 hours. There were plenty of stops at stations with no baggage or passenger operation. On repeated instances some of our passengers got out from the train to collect wild flowers, others joining football training in progress near the station buildings. Meanwhile the engine was getting pepped up and we proceeded farther.

Tashkent Observatory, which comprises astronomical, meteorological, and seismological divisions, is an old institution and is about to celebrate its fiftieth anniversary. No important additions to the telescopic equip-

ment have been made for many years, except a new transit instrument for time determinations and a Rosenberg photometer. The main instrument is the double refractor carrying a 13-inch (1:10) photographic and a 10-inch visual lens. The satellites of Uranus are being photographed for position work, certain clusters from among those which were photographed some 30 to 35 years ago are being rephotographed, and some variables are under observation with the double refractor. Comets are observed with the 10-inch guiding telescope, and extensive work on variable stars is in progress with the 5-inch comet-seeker. Meteors are also observed. Work on theoretical astronomy is also in progress. Magazines from abroad and publications of various observatories are reaching the out-of-the-way spot of Asia more or less regularly and the library contains about fifteen thousand volumes and pamphlets.

The city of Tashkent, with its 120,000 Russian population does not feature anything which would interest an average tourist, but men of learning will be interested to hear that there is a university with some three thousand students, a public library containing some 120,000 volumes and several research and educational institutions.

I remember reading in Simon Newcomb's *Memoires* that quite a few years ago he visited the famous Pulkovo Observatory near St. Petersbourg (now Leningrad) and was wondering how the staff could live in that observatory so perfectly isolated from the civilized world. Since that time the situation has not gotten any better. Poulkovo is only ten miles by rail from the former Russian capital, but the railway station is some three miles from the observatory and there are no means of transportation and no cheerful auto drivers to pick you up. Now there is a nearer train stop, about one and a half miles from the observatory hill, but the road is just plain mushy mud, some six to eight inches thick, and marshes on both sides. At night, of course, there is nothing but the stars to provide illumination.

Since I was in Poulkovo over five years ago, some interesting events took place in that renowned observatory. When founded about ninety years ago it was meant exclusively for astrometric work and is still keeping the foremost place in that field. Among the items in this particular line of work one can mention first the recent transportation of the large vertical circle from the old main building to a separate modern housing, and secondly the new fundamental catalogue which will contain fewer stars than the previous catalogues but instead will give their position with much higher precision. One more item must be mentioned in the field of astrometry. A new, small photographic refractor by Zeiss was installed in a fine dome; it is meant for an international enterprise —a photographic reobservation of stars of the *Astronomische Gesellschaft Catalogues.*

With time, astrophysical work has developed in Poulkovo,—spectral doubles, radial velocities, and photometry with spectralphotometry were the main phases of research in the previous years.

It was pleasant again to shake hands with Professor Belopolsky, cheerfully beaming and, in spite of his 75 years, very animatedly telling me the story of the difficulties they have had in connection with obtaining from Grubb-Parsons Company a 41-inch lens for a refractor. Belopolsky never cared for any assistants, but now there are a number of young people, he counted some four or five perhaps, who are clustering around the work on the big 30-inch refractor. Both observational work and modern spectroscopic theory are being done.

A new instrument, a solar spectrograph, was installed in Poulkovo about five years ago. The light of the sun is received by a coelostat mounted on the roof of the laboratory building and directed on a lens which gives the sun's image on the slit of a powerful spectrograph installed in the laboratory. The instrument was intended for investigation of the rotation of the sun in the spectral region 3800 to 4000 Å, which is Poulkovo's part in the international work. The instrument is regularly operated but is usually closed for winter because of the low position of the sun (about 60° Lat.). A large number of spectrograms has been obtained, which are awaiting reduction.

A number of years ago, an interesting method for rapid photographic determination of star colors was suggested by Tikhoff, which he called "longitudinal spectrograph" method. Up to the present, by means of this method some twenty-five thousand stars were classified according to their color. A catalogue together with discussion is being prepared for publication. The acquisition of a Koch self-registering microphotometer is among the plans for the near future.

By far the most important event during the last few years was of course the installation of the 40-inch reflector in Simeis, Crimea—the branch observatory of Poulkovo. The telescope was ordered from Grubb Company before the war, and finally after much negotiation was completed, brought over to Russia, and mounted some four years ago.

To test the efficiency of the mirror for accurate position work photographic measurements of double stars were undertaken. They showed good working qualities of the instrument. Two spectrographs with one and three prisms are available. Radial velocity work and special investigations on modern spectroscopy are being done. Among the latter an interesting study on the rotation of stars was carried out in coöperation with the Yerkes Observatory.

On my way through Moscow, I visited the Astrophysical Institute. They have now in their laboratory two Hartmann microphotometers; a self-registering microphotometer obtained last spring; a luxurious measuring machine by Askania Werke is also available. Perhaps the most interesting work in progress is that on the physical nature of comets. An expedition to the recent solar eclipse in Sweden was organized.

There is one more astronomical place in Moscow—the University Observatory. Years ago it became widely known among astronomers through investigations on the mechanical theory of cometary forms and

its variable star work. It is the best Russian observatory for the instruction of students. The principal instrument is a double refractor carrying a photographic and a visual lens both 15 inches in diameter. But their 5-inch camera is by far better known by astronomers abroad, because so many variable stars were discovered on plates taken with that camera.

In Leningrad there is an Astronomical Institute. Its main tasks are the small planets and the publication of an astronomical almanac; also geodetical work (gravimetry) and expeditions connected with it are an important part of its activity. Among special work one can mention studies on stellar statistics. There is a Russian Astronomical Association which had its most recent meeting last winter in Leningrad. An Astronomical Journal, mainly in Russian, is being published regularly.

Astronomy is quite favored by amateurs in Russia who are clustering around several amateur societies. The largest and the most active one is *Mirovedenie* in Leningrad which has published since 1911 an interesting magazine dealing not only with astronomy but also with some related sciences like meteorology, etc. There are also smaller amateur societies in Moscow (Bulletin) and Nijni-Novgorod (Bulletin and Amateur Almanac). Local astronomical clubs are active in a number of larger cities.

Among the latest professional news I would mention this. I was told in Poulkovo that in Rostov-Don University Observatory there will be a 15-inch refractor with the first moving floor in Russia.

LENINGRAD, NOVEMBER, 1929.

AMERICAN ASTRONOMICAL SOCIETY

REPORTS OF OBSERVATORIES 1928-1929

The reports which follow are for twelve months ending June 30, 1929, unless otherwise noted.

ALLEGHENY OBSERVATORY

PITTSBURGH, PENNSYLVANIA

Satisfactory progress continues to be made on the three major programs to which the Observatory limits its activities.

A. *Stellar Parallax.* Plates of serial numbers 39,677 to 41,023 were taken with the Thaw Photographic Refractor; about 80% of these are for parallax. Nearly four hundred regions are now completed and awaiting measurement. A set of 43 permanent sectors has been constructed for this work in the Observatory's instrument shop, giving magnitude reductions from 0.2 to 8.6 magnitudes in steps of 0.2 magn.

They have been found to possess marked advantages over the adjustable sector formerly employed, giving a most desirable permanency of match to all the plates of a given region, in addition to savin gconsiderable observing time and effort.

B. *Photographic Photometry.* Assisted by a grant from the National Academy of Sciences, Mr. Jordan has prepared the manuscript for *Publications,* volume VII, part 2, "The Light Curves of Fifteen Eclipsing Variables."

C. *Spectrographic Researches.* Mr. Burns, in coöperation with Dr. F. M. Walters of the Carnegie Institute of Technology, has published an extensive paper, "Wave Lengths and Atomic Levels in the Spectrum of the Vacuum Iron Arc" (*Publ. Allegheny Obs.,* **6**, 11). Miss Mary E. Warga, a graduate student under his supervision, has completed an investigation on magnesium triplets in arc and solar spectra (*Publ. Allegheny Obs.,* **6**, 10).

An ingenious attachment to the measuring engine was devised by Mr. Burns, and constructed in the instrument shop. Three wheels, with divisions on silver to the *squares* of numbers, are connected by 1 to 10 gearing with the shaft of the micrometer screw. By measuring the diameters of three interference rings successively on these heads, a very considerable amount of time and computation is obviated. A description of the device will appear soon in the *Journal of the Optical Society of America.*

From January to July, 1929, Director Curtis was on leave, with the Swarthmore Eclipse Expedition under Dr. J. A. Miller, for observation of the total solar eclipse of May 9 at Takengon, Sumatra.

Nearly six thousand visitors have attended the Frick Public Evening Service, in charge of Mr. W. R. Ludewig.

HEBER D. CURTIS, *Director.*

BUREAU OF STANDARDS

DEPARTMENT OF COMMERCE

WASHINGTON, D. C.

(For the year 1929)

The following is a brief report of the work of the Bureau of Standards in the field of astrophysics during the past year.

The revision of Rowland's preliminary table of solar spectrum wavelengths published last year by the Carnegie Institution of Washington lists 57 elements identified in the sun's atmosphere. These account for approximately 57 per cent of the 22,000 solar lines; identification of the remainder is still a puzzle. The possibility of recognizing other elements in the sun is in many cases handicapped by the limitations in our knowledge of their spectra. This applies especially to the halogens and to the heavier rare gases, the spectra of which were not fully described or classified. Although it could have been predicted that the excitation

potentials for these elements are relatively high and that their detection in the solar spectrum would therefore be doubtful unless their abundance were large, the question could not be settled without new spectroscopic data. During the past year the spectroscopy section of the Bureau has made completely new descriptions of the emission spectra of neutral chlorine, bromine, krypton, and xenon atoms, and in each case most of the lines have been interpreted in terms of atomic energies. These results have indicated the lines which might be expected to reveal these particular elements as constituents of the solar atmosphere; comparison with the solar spectrum shows that the lines are not present. The excitation and first ionization potentials of these gases do not differ greatly from those of hydrogen, and it appears that the prominence of hydrogen lines in the solar spectrum must be ascribed to an overwhelming abundance of this element in the sun's atmosphere. The non-appearance of lines characteristic of chlorine, bromine, krypton, and xenon does not necessarily mean that these elements are absent; it indicates that these gases are very rare in the sun compared with hydrogen or oxygen.

The photographic emulsion laboratory has compared resolution and speed of three different types of photographic plates when developed with standard developers and with a number of special ones recommended for improving resolution. The results will be published in the *Bureau of Standards Journal of Research.*

Continuing the work on spectral sensitization of photographic emulsions, a satisfactory explanation of hypersensitization has been found, and will be applicable to methods of color sensitizing plates by bathing in dye solutions.

During September, measurements were made at two elevations (7,250 and 10,500 feet) at Flagstaff, Arizona, to determine the amount of incoming ultra-violet radiation at these higher elevations as compared with a station practically at sea level—Washington, D. C. An interesting result is the observation that, while the spectral quality of the ultra-violet at the 10,500 feet station is appreciably different (being richer in short wave length ultra-violet) from that at the 7,250 feet elevation, the total amount of ultra-violet, of wave-lengths less than 310 m μ, is practically the same at these two stations. This results from the increased scattering of ultra-violet radiation at the lower (7,250 feet) level.

An improved value for the constant of gravitation, based on all the calculations thus far completed, has been secured. This is

$$6.668 \times 10^{-8}\ \mathrm{cm^3/gm\ sec^2}$$

It is not believed that the few calculations still awaiting completion will result in any considerable change in this 'ue.

A method of obtaining seconds signals good to approximately 0.0001 second from the Bureau's Riefler clock has been developed. A beam of light falls on a concave mirror, mounted on the pendulum of the clock, and is reflected onto a photoelectric cell. The action of the cell is ampli-

fied through a two-stage resistance coupled amplifier to a distributing relay. From this relay the signal may be transmitted to the various laboratories as desired.

UNIVERSITY OF CALIFORNIA

BERKELEY ASTRONOMICAL DEPARTMENT

STUDENTS' OBSERVATORY

Mr. Einarsson exchanged with Mr. Jeffers of the Lick Observatory during the second half year. At the Lick Observatory, Mr. Einarsson was chiefly engaged in the determination of astrographic positions. Those of Comet *a* 1929 (Schwassmann-Wachmann) have been published.

The library has been materially increased through the gift by the Astronomical Society of the Pacific of its library to the Students' Observatory. The Society has retained only works of general and historical interest, which are also kept at the Students' Observatory. The library has been entirely re-arranged and considerable necessary binding has been done.

Mr. Crawford has prepared the manuscript of an elementary text for the determination of preliminary orbits. His purpose has been to present in simple manner the modifications of Gauss' method by Merton and Laplace's method by Leuschner. The manuscript is now in press with the McGraw-Hill Book Company.

Mr. Shane spent two months during the summer of 1929 at the Mount Wilson Observatory for the purpose of securing plates to be used in the determination of line intensities in the solar spectrum. The measurement and reduction of these plates have been proceeding in a satisfactory manner. The work is purely experimental and does not aim at securing definitive results at this time but rather at the establishment of a satisfactory method of determining line contours.

As heretofore, orbits of the new comets and of some minor planets have been derived. Mention should be made of the parabolic orbit from one-day intervals, by Messrs. F. L. Whipple and H. S. Mendenhall, of Comet *c* 1928 (Forbes) and of an elliptic orbit of the same comet by Mr. H. Thiele from an arc extending over two weeks; also of the work of Miss Anne S. Young on Comet *a* 1929 (Schwassmann-Wachmann) and of Messrs. C. J. Krieger and D. C. Duncan on the orbit of minor planet Y. O. 6 (1922 MY). Mrs. Maud W. Makemson has published an investigation of the orbit, mass, and parallax of 99 Herculis.

Mr. Kaster has developed several improvements on his position finder for the determination, without the use of tables, of the hour angle, latitude, or geographical coördinates of points on the Sumner line, at sea and in the air. Through the generosity of Mr. Ralph Ellis of Berkeley, an improved model has been constructed by Howell and Sherburne of Pasadena. Tests are being continued with the hearty coöperation of the U. S. Navy. The original model is still with the Byrd Expedition

to the Antarctic. As stated in the previous report, the performance of the instrument exceeds expectations.

Mr. Thiele, with the assistance of Mrs. Maud W. Makemson, has completed the preparation of the research surveys of the minor planets, under the general direction of Mr. Leuschner. The manuscript is now being revised for publication. The purpose of the research surveys has been set forth in previous reports.

During the year, Mr. R. S. Richardson and Mrs. Katherine Prescott Kaster have been attached to the staff of the Mount Wilson Observatory as assistants. Mr. C. E. Smith has served as instructor at the Teachers College at Fresno and Mr. Kaster has served as temporary instructor at Pomona College. All four have returned as resident graduate students for the degree of Ph.D. at Berkeley.

Miss Anne S. Young, Professor of Astronomy at Mount Holyoke College, has spent the year at Berkeley in study and during that time has completed the orbit referred to above of the Schwassmann-Wachmann comet, from an arc extending from 1928 December 19 to 1929 March 8. Observations taken subsequently, on March 29, 31, and April 27 are well represented.

In April, Mr. J. Ueta, Assistant Professor of Astronomy at Kyoto Imperial University, took up his residence at the University for study and research in orbit theory and perturbations under the direction of Messrs. Leuschner and Crawford.

Messrs. C. J. Krieger, L. B. Berman, and H. S. Mendenhall have completed their work for the degree of Doctor of Philosophy, with majors in Astrophysics. The subjects of the theses, for which the material was obtained at the Lick Observatory, were: Krieger, "A Determination of Magnitudes, Spectral Types and Color Indices in the Scutum Cloud with a Statistical Discussion" (under the direction of Dr. R. J. Trumpler); Berman, "A Spectrophotometric Study of Certain Planetary Nebulae" (under the direction of Dr. J. H. Moore); Mendenhall, "A Spectrographic Study of Beta Cephei" (under the direction of Dr. J. H. Moore). Messrs. Krieger, Berman, and Mendenhall have received appointments as instructors at St. Louis University, Carleton College, and Montana State College respectively.

The Astronomical Society of the Pacific met with the Pacific Division of the A.A.A.S. at Berkeley, June 19 to 22, 1929, with a highly representative attendance of astronomers. The program has been published in full in *Science* and in *Popular Astronomy*. Papers by members of the Berkeley Astronomical Department were: "Report on the progress of the research surveys of the minor planets," A. O. Leuschner and H. Thiele; "Comparison of theory and observation for 12 minor planets discovered by James C. Watson," Maud W. Makemson and A. O. Leuschner; "On the number of solutions in Leuschner's parabolic orbit method," R. H. Sciobereti; "Elimination of parallax and determinateness of planetary orbit solutions," Mrs. C. H. Smiley (Margaret K. Holbrook) and A. O. Leuschner; "The Schwassmann-Wachmann

comet," Miss Anne S. Young.

As a result of the comparison of theory and observation for 12 minor planets discovered by James C. Watson, it was found that an accuracy far exceeding expectations has been attained in the prediction of the motion of minor planets under the disturbing attraction of Jupiter. The original investigations were begun at the suggestion of Simon Newcomb in 1901 by Mr. Leuschner, with the assistance mainly of Messrs. Crawford and Ross, under the auspices of the National Academy of Sciences, and were published in 1910. At that time it was hoped that the results might remain valid until about the year 1930, when, according to past experience, a revision of the calculations was expected to become necessary. However, the departures of the planets concerned, as determined for the 11 years from 1918 to 1929, have been found insignificant for all practical purposes, so that the predictions based on the Berkeley calculations are now certain to hold for many decades to come, without revision.

Mrs. Smiley has applied Leuschner's method of complete elimination of the parallax in the determination of the orbit of Minor Planet 1900 GA. European astronomers have compared the calculations made on this planet many years ago, without elimination of the parallax, a refinement then not practiced, with recent recomputations by modifications of older methods, with the use of the now well-established elimination of the parallax. Mrs. Smiley's computation has yielded accurate results in the first approximation.

Mr. Sciobereti's work on the number of solutions in Leuschner's parabolic orbit method involves the use of a nomograph in determining the roots of the equation for the geocentric distance.

A. O. LEUSCHNER, *Director.*

CINCINNATI OBSERVATORY

CINCINNATI, OHIO

Meridian circle observations of Eros comparison stars between declinations zero and 10° south were completed, and the results published in the *Astronomical Journal.* Observations of proper-motion stars have been continued as heretofore both with the meridian circle and with the equatorial.

In the prosecution of the work of collecting all proper-motions exceeding four-tenths of a second a year, a comparison was made of motions found by Luyten with the blink microscope (*Harvard Circulars* 310, 324, 325) and the motions from meridian observations. These results were published in the *Astronomical Journal,* No. 917, and seem to show that the blink microscope method is subject to large errors. A similar comparison of our own results with the motions published by Ross in several numbers of the *Astronomical Journal* is now under way, and will soon be published.

J. G. PORTER, *Director.*

OBSERVATORIO NACIONAL ARGENTINO

CÓRDOBA, ARGENTINA

(For the year 1928)

The year 1928 is an important one in the history of the Córdoba Observatory.

It marked the termination of the observations (and practically of the reductions also) of the programs of work inaugurated by Gould and subsequently by Thome; the completion of the fundamental series of observations begun in 1913; the resumption of work on the large reflector and the new administration building in Córdoba.

The Córdoba Durchmusterung, both maps and catalogs, will be completly terminated early in 1929 and the final zones published. The maps are nearly all ready now.

The measures of the sixth zone (—29°) of the Astrographic Catalog were published during the year as Vol. 31 of the *Resultados*. The measures for the two remaining zones are completely ready for the printer and it is hoped to print at least one of them in 1929. The unusual amount of printing is taxing the resources of the Observatory to such an extent that it is doubtful if both can be issued in 1929.

The reductions of the *repère* stars are well along and it is hoped to complete them by the middle of 1929 and to complete the plate constants and have the ninth and last volume of the Astrographic Catalogs ready for the printer by the close of the year.

The plates for the Astrographic Chart (Carte du Ciel) have all been taken several years ago. The engraving has been interrupted in an effort to obtain better results for the sky background.

The reductions and discussion of the series of strictly fundamental observations with the new Repsold Meridian Circle begun in 1913 were completed and the resulting catalog is ready for printing. It will be issued as soon as possible. The resulting positions are highly satisfactory.

Observations of a fundamental nature and for special investigations in recent years will be published later.

The observations for the remaining zone of the extension of A.G. Zone Catalogs (—37° to —52°) will be begun as soon as observers can be released from the reductions now in hand and the wiring in the new building connecting the clocks and Meridian Circle is installed.

The reductions of the photometric observations of Halley's Comet are well under way but have been delayed by the necessity of collateral investigations. These are nearly completed and the MS. should be ready for the printer early in 1929. Beyond the 34,580 observations required to complete the Durchmusterung program and the necessary observations for time, the only others attempted were with a new spectrograph attached to the Astrographic telescope for the determination of the radial velocities of globular clusters and nebulae. These were suspended because of the reconstruction work on the building and be-

cause the light-gathering power of that telescope necessitated excessive exposures.

The work of completing the new administration building in Córdoba with domes for the housing of the 75-centimeter reflector, the 5-inch Clark refractor (DM. telescope), and the photographic portrait lenses, was resumed in September and all will be completed early in 1929.

Detailed plans were completed and approved for the dome and auxiliary buildings for the large reflector in the Sierras. Funds were provided and orders given for its early termination. A generous donation of land by the new owners of the Estancia "Bosque Alegre" provides for the private road to connect the site for the telescope with the main road, for additional sites for telescopes and buildings in the future and a fine spring of water in the near-by gulch.

The usual public services were maintained except that visitors could not be admitted on account of construction work. An automatic device was perfected by 1st Astronomer Zimmer for answering the calls for time over the telephone.

C. D. Perrine, *Director.*

DEARBORN OBSERVATORY

Northwestern University

Evanston, Illinois

During this period the work of the Dearborn Observatory has been directed to the photographic observations for stellar parallax, micrometric and photographic observations of double stars, photographic work on the planets, and stellar spectrographic investigations.

The manuscript for Volume III of the *Annals of the Dearborn Observatory,* containing the Observatory's results of the determinations of stellar parallax, is ready and awaits publication.

A paper giving the preliminary work on the photographic observations of double stars was published by Mr. A. H. Hoff in the current volume of the *Astronomical Journal.*

Certain stellar spectrographic observations have profited by the courtesies of the Yerkes Observatory and of the Ryerson Laboratory of the University of Chicago in the use of their registering microphotometers. (See paper by Miss Anger on the Spectrum of Alpha (2) Canum Venaticorum, *Ap. J.,* **70**, Sept., 1929.)

Manuscript by Mr. C. T. Elvey on "Contours of H Lines in Some Stars of Spectral Type A," is ready for publication in the *Annals* of the Observatory.

Mr. Frank D. Urie of the Elgin Observatory continued his experimental work with the photo-electric cell until his appointment as Head of the Research Laboratory of the Elgin National Watch Company necessitated a temporary discontinuance.

In instrumental equipment should be mentioned the reconstruction of the temperature case for the spectrograph, providing thermostatic con-

trol; the acquisition of a stereo-comparator made in the instrument shops of the Yale Observatory on Dr. Schlesinger's design; and the commencement of the construction of a registering microphotometer following designs by Professor Hughes of Washington University.

In the matter of staff, Dr. O. J. Lee was appointed Assistant Professor of Astronomy in replacement of Mr. Elvey, who resigned to accept appointment at the Yerkes Observatory. At the commencement season, 1929, the undersigned resigned as Director of the Dearborn Observatory and accepted appointment as Director of the Adler Planetarium and Astronomical Museum of Chicago.

PHILIP FOX.

DOMINION OBSERVATORY

OTTAWA, CANADA

Meridian Work and Time Service. With the meridian circle there were 2060 observations of stars, 168 of the sun and planets, and 864 of nadir and other constants. The time service in government buildings was continued and somewhat increased. Time was distributed by clock beats over the telephone, by telegraph line at noon, by broadcast through radio station CNRO at 3:00 P.M., and by broadcast from the Observatory on a wave-length of 40.8 metres at the same hour. Time signals from Annapolis, Bordeaux, Nauen, and Rugby were received regularly by coincidence methods, and frequently by automatic registration.

Solar Physics. More than 200 observations of solar limbs and centre, with iodine comparison spectra, were made, and 108 direct photographs recording sunspots. About 450 measurements of spectrum plates were made and computed. The graduated sphere with coördinate frame for reading the latitude and longitude of observed points on the sun was completed and dispenses with a great deal of computation. Measurements made of four spruce trees from Quebec, and a butternut from Ottawa, revealed in their annual growth-rings the sunspot influence slightly out of phase.

Fifteen-inch Equatorial. Spectrographic work on the brighter Cepheids was continued and 242 spectrograms were obtained. A complete and interesting series of spectrograms of ϵ Aurigae was secured during its period of eclipse. There was also obtained a complete series of spectrograms of the spectroscopic triple system η Virginis. The telescope was as usual available to visitors for two hours every Saturday night.

Photographic Photometry. Observations on the Cepheid fields included in the previous coöperative program were continued until the latter part of August, 1928, when they were discontinued in view of the new program being prepared by Commission No. 27 of the I.A.U. Photographic charts and lists of magnitudes of comparison stars in sixteen of the original fields were sent out to a few stations where plates of these fields had been obtained. Measurements of the magnitudes of

SU Draconis, RS Bootis, SZ Aquilae, RV Ursae Majoris, TT Aquilae, RS Cassiopeiae, SW Draconis, Y Lacertae, and X Lacertae were made on some four hundred plates.

Seismology. There were 336 earthquakes registered. Those of sufficient importance were reported to the press and by telegraph to Science Service, Washington. Monthly bulletins were distributed to 237 stations. The standard seismographs at Ottawa, Saskatoon, and Halifax, as well as the short-period instruments at Shawinigan Falls and Seven Falls, Quebec, were in practically continuous operation. In order to provide more time for research it has been decided to discontinue preparation and publication of the series "Location of Epicentres," the last number to appear being that for 1927, now in preparation. The *Bibliographical Bulletin* of the Eastern Section of the Seismological Society of America, edited since its inception by the seismologist of this observatory, has now, under an arrangement with the Eastern Section, been definitely taken over as one of the Publications of the Dominion Observatory. Beginning with January, 1929, it is issued under the title, *Bibliography of Seismology.*

Terrestrial Magnetism. During the year magnetic observations were confined to two comparatively small sections of the Dominion. In one of these, included between longitudes 71° W and 82° W and latitudes 45° N and 50° N, declination, inclination, and horizontal intensity were observed at 8 repeat and 3 new stations. In the other section, in the region of Hudson strait, declination, inclination, and total intensity by Lloyd's method were observed at 6 stations representing 5 distinct localities, namely, Port Burwell, Resolution island, Cape Hopes Advance (2 stations), Wakeham bay, and Nottingham island.

Gravity. Relative determinations with a half seconds pendulum apparatus were made at Potsdam, Greenwich, Ottawa, and Washington. An investigation was made in Europe of the application in Great Britain and on the continent of geophysical methods of prospecting.

R. Meldrum Stewart, *Director.*

DOMINION ASTROPHYSICAL OBSERVATORY

Victoria, British Columbia

(For the year ending March 31, 1929)

This is the eleventh annual report of the work of this institution, which commenced actual observations on May 6, 1918. The details of the work carried on are published in complete form in the *Publications* of the Observatory, of which seven were issued during the year. Three more are in press, being numbers 12 to 14, inclusive, of Volume IV.

Staff. Mr. H. H. Plaskett, who had been on leave from February, 1928, resigned in August of the same year to accept a position at Harvard. Mr. R. O. Redman of Cambridge, England, was appointed temporary assistant in August and has been on the staff since then.

Mr. P. M. Millman, a university student, again spent a few months of the summer vacation in observing and measuring spectra.

Observing. As in previous years, the whole time of the telescope, except two hours for visitors every Saturday evening, was devoted to photographing stellar spectra. The observing weather was somewhat better than the average for the preceding ten years, as a total of 1346.4 hours observing was secured for stellar work as against a ten-year average of 1236.7 hours. The number of spectra secured was 1317 as against a ten-year average of 1590 but it must be remembered that there are now more long-exposure spectra than formerly. In particular one observer took 46 nights to obtain 93 plates. Spectra were secured on 214 nights as against the ten-year average of 204 nights. Of these nights 123 might be classed as fair to good when five or more plates were secured, the total on such nights amounting to 1116 plates. Poorer nights numbered 91, with a total accumulation of 201 plates.

Programmes. B Stars. The programme of observing of the B-type stars which has been under way for about five years is now approaching completion. Practically all the plates required have now been secured and over 500 spectrograms of these stars were measured during the year. Some stars formerly classified as B are found to be of O type. With those previously observed at this observatory there are now about 460 O- and B-type stars whose velocities have been determined solely at this institution. Several plates each of 180 other B stars, previously observed at other places, have been made and combined with the previous observations to give a mean result for the radial velocity. Considerable computation in connection with the proper-motion data of these stars has been carried out and their galactic coördinates and distances to the solar apex have been deduced. It is planned to use the results for determining anew the solar motion, the mean distances and absolute magnitudes of the various spectral classes of the B stars and for a more thorough investigation of the rotation of the galaxy referred to in the last report.

A Stars. The spectra of over 1000 A-type stars have now been secured. The number of plates of each star varies widely and in the winter section of the sky where these stars are most numerous and the weather the poorest, many of the stars are represented by a single plate. Much remains to be done in the winter season but it is hoped that another year will see the programme nearing completion. Nearly 500 of these A-type spectra have been measured during the year and, as is the case in the B programme also, measurement practically keeps pace with observation.

Binary Orbits. The orbits of four new spectroscopic binaries have been determined during the year. These are of A Persei, Boss 4177, H.R. 7338, and H.D. 32990. The massive star Y Cygni has been reobserved, the earlier spectrograms remeasured and a new determination made of the orbital elements. A revision has been effected in the

orbital elements for Boss 809 which results in much better agreement with the observations. Several other binaries are under investigation, some of long period being followed at intervals for possible changes of period.

Wolf-Rayet Stars. The wave-lengths of the oxygen and nitrogen lines between λ 3800 and λ 4700 on third order grating tables have been measured. An investigation has been undertaken of all the Wolf-Rayet stars visible at Victoria. The data obtained have been studied with a view to determining the causes of broad band emission and also for the purpose of formulating a system of classification for these stars.

New Programmes. New programmes for observing have been prepared. One deals with the faint and distant K-type stars in the galactic regions for which spectra are now being secured and measured. The results will be used in a further study of the galactic rotation. A similar use will be made of spectra of the so-called "c" stars as it is hoped to secure observations of all those not previously observed for radial velocity. Another programme has recently been commenced of 500 O-B5 stars fainter than magnitude 7.5 and north of the equator and is a continuation of the programme of B stars brighter than magnitude 7.5 now completed.

New Equipment. During the year a 6-inch finder, to which a photographic adapter was added, has been attached to the large telescope. The shorter focal length of this as compared to the 7-inch finder makes it easier to pick up the fainter stars now becoming more frequent on our programmes. Piers on which to place the small equatorial and sun-dial were constructed during the year.

Visitors. Many noted astronomers from all over the world have visited the Observatory of late. Including day visitors approximately 35,000 persons visited the institution during the year.

J. S. Plaskett, *Director.*

DUDLEY OBSERVATORY

Albany, New York

Reductions of Observations. The Albany Catalog of positions of 20,775 stars for the epoch 1910.0 has been completed, and, except for the introduction, has been put into manuscript. Work on the General Catalog of positions and proper motions of more than 30,000 stars has progressed rapidly. The derivations of the systematic corrections and weights of some eighty catalogs not previously investigated have been completed. Some of the newer catalogs have been kindly supplied by the authors in manuscript. The positional history of each star in our card catalog is essentially complete to date. The comparisons of the observed positions with provisional ephemerides is well under way and the application of the systematic corrections to the differences has been started. Preliminary steps have been taken toward correcting the sys-

tem of the *Preliminary General Catalogue*. New material has been used for a comparison of declinations observed from opposite sides of the equator for the revision of the adopted refractions. The indications are that the corrections to the declinations depending upon declination will not differ materially from those found several years ago. As a first step in the revision of the right ascension system of the *Preliminary General Catalogue*, the magnitude equation resulting from a combination of the Albany and San Luis observations has been determined.

Space Motions. Messrs. Raymond and Wilson have continued their studies of space motions, with especial emphasis upon the asymmetry in the motions and its explanation as an effect of the rotation of the galactic system about its center. They find the limiting value of the solar motion to be 14.8 km/sec toward ($A = 268°$, $D = +22°$), all three coördinates increasing with velocity dispersion, the speed following Stromberg's parabolic relation, and the motion taking place in a plane making an angle of about 6° with the plane of the Milky Way. The centers of the velocity ellipsoids representing the motions do not lie along a straight line, but are better satisfied by the arc of a circle, the center of which lies in galactic longitude 306° and the radius of curvature of which is 286 km/sec. Considering the probable errors involved it would appear that the motion is around the center of the galactic system ($l = 325°$) and that through the radius of curvature we have another measure of the speed of rotation of that system. Further studies of the direction of the galactic center as indicated by the preferential motions, of the ratios of the axes of the velocity ellipsoids in the galactic plane, and of the constants in the formulae representing the observable differential rotational effects in both radial velocities and proper motions, give values in good accord with earlier theoretical and practical studies of rotational effects. They give definite indications that the sun and its neighboring stars are being carried around the galactic center at a speed of about 286 km/sec.

Stellar Wave-Lengths. Mr. Albrecht has completed the identification and determination of wave-lengths of more than 900 lines in the spectrum of γ Geminorum. These wave-lengths are offered as a contribution toward the problem of establishing a list of normal wave-lengths observable in Class-A spectra.

BENJAMIN BOSS, *Director.*

(To be continued.)

PLANET NOTES FOR APRIL

By CLIFFORD E. SMITH.

The *Sun* will be moving northeast from the central part of Pisces to the central part of Aries. On April 28 there will be an eclipse of the sun visible as a partial eclipse in the United States. This eclipse will be total only about thirty-eight minutes during the central part of its path. It will become total in the Pacific off from San Francisco. It touches the mainland just north of San Francisco, and continues northeast into Montana where it becomes annular again. This eclipse, of course, will be total at any particular place for only a second or so.

The position of the sun the first and last days of the month will be respectively: R.A. $0^h\ 39^m$, Decl. $+4°\ 10'$; and R.A. $2^h\ 26^m$, Decl. $+14°\ 29'$.

The phases of the *Moon* will occur as follows:

First Quarter	April	6 at	5 A.M.	C.S.T.
Full Moon		12 "	12 P.M.	"
Last Quarter		20 "	4 P.M.	"
New Moon		28 "	1 P.M.	"

Perigee will occur on April 9, and apogee on April 21. On April 13 there will be a partial eclipse of the moon which will be visible in North America.

Mercury will be moving northeast from the central part of Pisces, across Aries, to the western part of Taurus. On April 12 it will pass through its perihelion point, on April 22 and April 27 it will be in conjunction with Venus, and on April 27 it will be at its greatest elongation east. At the end of the month Mercury will be a degree or so southeast of the Pleiades, and that time it will set about an hour and a quarter after the sun.

Venus will be about an hour east of the sun in apparent position. Thus it will be an evening star, and it will set about an hour after the sun. Its apparent motion will be easterly and, as has been mentioned, it will be in conjunction with Mercury on April 22 and April 27.

Mars will be moving northeast from the central part of Aquarius to the central part of Pisces. On April 22 it will pass through its perihelion point, and, on April 25, will be in conjunction with the moon. It will be a morning object, and will rise about two hours before the sun.

Jupiter will be in central Taurus. It will be an evening object during this period, and at the end of the month it will set about two hours after the sun. On April 4 it will be in conjunction with the moon.

Saturn will be in central Sagittarius. On April 2 it will be at quadrature west of the sun, thus, early in the month, it will rise some little time after midnight for northern observers since it will be more than 22 degrees south. On April 19 it will be in conjunction with the moon, and on April 21 its apparent motion will change from direct motion to retrograde.

Uranus will be near the sun in apparent position during this period, conjunction occurring on April 1.

Neptune will be in Leo about two degrees in a southeasterly direction from Regulus. During the middle of the month it will be on the meridian about 9:00 P.M. Standard Time. On April 9 it will be in conjunction with the moon.

OCCULTATIONS

Occultations Visible at Washington.

[From the *American Ephemeris.*]

Date 1930	Star	Mag.	IMMERSION Washington C.T.	IMMERSION *a*	IMMERSION *b*	IMMERSION Angle E from N	EMERSION Washington C.T.	EMERSION *a*	EMERSION *b*	EMERSION Angle E from N
			h m	m	m	°	h m	m	m	°
Apr. 2	133 B.Tau	5.9	22 14	—0.3	+0.6	32	22 47	+1.1	—2.1	310
7	ω Cnc	6.1	0 20	—0.7	—0.5	63	0 57	+0.8	—2.2	335
7	4 Cnc	6.2	0 39	+0.1	—1.5	115	1 31	+0.3	—1.3	282
9	107 B.Leo	6.3	3 23	+0.4	—1.7	146	4 6	+0.4	—1.0	265
16	24 G.Sco	6.2	1 18	—1.9	+0.2	106	2 42	—1.8	—0.8	305
18	210 B.Sco	5.8	1 16	—0.2	—0.8	152	2 11	—2.6	+1.9	236
30	62 Tau	6.1	18 46	—0.4	—1.5	88	19 45	—0.1	—0.9	260

The quantities in the columns *a* and *b* are given for the purpose of making these predictions useful for any place within 200 or 300 miles of Washington. The procedure is as follows: Subtract the longitude of Washington (77°.1) from the longitude of the place in question; multiply the result, taking the signs into account, by the quantity under *a* for the star to be observed; similarly, with the latitude (38°.9) using *b*; apply the sum of the products, with its proper sign, to the Washington C.T., and obtain the predicted Washington Civil Time for the phenomenon at the place of observation.

Occultations Visible at Omaha and Vicinity.

(Disappearances Only)

Date 1930	Star	Mag.	G.C.T.	*a*	*b*	P
			h m	m	m	°
April 3	133 B. Tauri	5.9	3 16	—0.5	+2.1	49
7	ω Cancri	6.1	5 11	—0.9	+1.3	90
7	4 Cancri	6.2	5 44	0.0	—0.4	138
9	107 B. Leonis	6.3	8 33	+0.3	—1.1	160

The approximate times for observers within 300 miles of Omaha can be found by using the constants *a* and *b*, given in the table, according to the formula

$$\text{G.C.T.} = \text{Predicted G.C.T.} + a\Delta\lambda + b\Delta\phi,$$

$\Delta\lambda$ and $\Delta\phi$ in this case being obtained by using the longitude (96°.0) and latitude (41°.3) of Omaha, and subtracting these, respectively, from the longitude and latitude of the place.

WM. CLETUS DOYLE, S. J.

Creighton University Observatory.

VARIABLE STARS.

Monthly Report of the American Association of Variable Star Observers for January, 1930.

Once again we have to report with deep regret the passing of another of our life members, Mr. Arthur C. Perry of Brooklyn, N. Y. He was seventy-eight years of age and had long been identified with variable star astronomy as an amateur observer. He was one of the earliest of American amateur observers, being for some years joint observer with the late Professor J. A. Parkhurst when the latter was also enrolled as an amateur observer. The discovery, in 1897, of

VARIABLE STAR OBSERVATIONS RECEIVED DURING JANUARY, 1930.

Nov. 0 = J.D. 2425916; Dec. 0 = J.D. 2425946; Jan. 0 = J.D. 2425977.

J.D.Est.Obs.

V Scl
000339
942 14.0 Bl
950 14.1 Dr

S Scl
001032
931 7.4 Bl
938 7.6 Ht
941 7.8 En
942 7.7 Bl
946 8.1 Ht
947 7.8 Dr
956 8.1 Dr
965 8.5 Dr
981 8.9 Pt

X And
001046
895 12.5 Nz
910 13.0 Nz
941 13.5 Nz
950 14.2 Nz
964 14.2 Nz
969 13.8 Ch
971 14.1 Nz
974 14.0 B
975 14.3 Nz
977 14.3 Nz
981[13.4 Bw

T Cet
001620
947 5.8 Tf
951 5.8 L
952 5.5 Tf
956 5.5 Tf
960 5.8 Tf
960 5.8 L
963 5.7 Tf
969 5.6 L
975 5.9 Tf

T And
001726
969 13.7 Ch
974 14.1 B

T Cas
001755
955 8.4 Ch
955 8.3 L
973 8.6 L
973 7.7 B
976 8.7 Pt
984 9.1 B

R And
001838
945 8.1 Ch
948 8.3 Ah
951 8.2 Ah
956 8.0 Ah
965 8.0 Ah
965 7.7 Sb
966 8.2 Ah

R And
001838
967 7.9 Ah
968 8.2 Ah
968 8.4 Gy
972 8.2 B
973 8.2 Ah
974 8.5 Ah
975 8.4 Ah
976 8.5 Pt
977 9.2 Wd
979 8.5 Fd
980 8.4 Ma
981 8.4 Gy
984 8.8 B

S Tuc
001862
938[13.2 Ht
942[14.0 Bl
947[14.0 Dr
950 14.4 Dr
965 13.3 Dr

S Cet
001909
949 10.5 Ch
955 10.3 L
963 9.4 Tf
966 9.5 Sf
969 9.4 L
975 8.6 Tf
976 8.9 Pt
977 8.6 Jo
980 8.8 Sf

T Scl
002438a
940 12.1 Dr
947 11.1 Dr
950 11.2 Dr
963 10.0 Dr

RR Scl
002438b
940 12.9 Dr

T Phe
002546
918 12.6 Ht
940 13.1 Dr
942 13.5 Bl
950 13.3 Dr
956 13.4 Dr

W Scl
002833
942 13.0 Bl
965 13.1 Dr

Y Cep
003179
954 14.0 L
973[13.9 L

U Cas
004047
969 13.3 Ch

U Cas
004047
976[14.0 B
977[13.9 L
981[13.3 Bw
993[13.3 Lg

RW And
004132
935 9.1 Lg
955 11.0 L
969 11.4 Ch
973 11.8 B
974 12.0 L
976 11.2 Pt
984 10.8 B

V And
004435
895 14.4 Nz
910 13.3 Nz
941 11.0 Nz
950 10.8 Nz
964 10.6 Nz
969 10.0 Ch
971 10.1 Nz
974 9.7 B
975 9.7 Nz
977 9.7 Nz

X Scl
004435
942 11.5 Bl

RR And
004533
895[14.8 Nz
941 13.5 Nz
950 12.8 Nz
964 12.4 Nz
969 11.4 Ch
971 11.7 Nz
975 11.4 Nz
976 11.5 B
977 11.3 Nz

RV Cas
004746a
969[13.2 Ch
974 14.7 B
976 15.0 Pt

— Cas
004746b
976 11.2 Pt

W Cas
004958
935 8.8 Lg
966 8.8 BL
967 8.6 BL
969 8.5 Ch
970 8.4 BL
972 9.0 BL
972 8.3 B
975 8.9 BL
976 9.0 BL

W Cas
004958
980 8.4 BL
980 8.7 Pt
981 8.2 BL
984 8.9 BL
984 8.5 B
986 8.2 BL
993 8.3 BL
993 8.7 Lg
995 8.7 BL

U Tuc
005475
931 8.5 Bl
940 9.6 Dr
942 9.5 Bl
944 9.9 Ht
950 10.0 Dr
963 11.1 Dr

Z Cet
010102
955 8.9 L
969 9.6 L
973 9.8 B
981 10.4 Pt

U Scl
010630
942[14.0 Bl
950 15.1 Dr

U And
010940
955 11.8 L
969 10.4 Ch
974 10.6 L
976 10.0 B

UZ And
011041
969 12.3 Ch
976 12.4 B
981 11.2 Ma
981 11.4 Bw

S Psc
011208
969 14.7 L
981[13.6 B

S Cas
011272
969[13.2 Ch
977 13.7 B

U Psc
011712
935 11.5 Lg
955 12.8 L
969 13.8 L
976 13.6 Pt

R Scl
012333a
939 6.3 Dr
956 5.8 Dr

RS Scl
012333b
939[13.4 Dr

RZ Per
012350
935 9.8 Lg
949 10.4 Ch
955 9.4 L
974 9.1 L
974 9.5 B

R Psc
012502
895 12.8 Nz
941 8.6 Nz
948 9.0 Ah
950 8.7 Nz
951 9.1 Ah
964 8.8 Ch
964 8.7 Nz
965 9.1 Ah
966 9.1 Ah
967 9.1 Ah
968 9.2 Ah
969 9.1 Ah
972 8.8 Nz
973 9.1 Ah
975 9.2 Ah
975 8.9 Nz
976 8.4 Pt
977 8.6 Nz

RU And
013238
935 10.8 Lg
969 11.7 Ch
969 12.2 L
976 12.5 Pt

Y And
013338
935[13.2 Lg
969 13.8 Ch
969 14.4 L
974[13.7 B

X Cas
014958
965 12.4 Bn
974 11.6 B
977 12.3 Bn
982 12.4 Bn

U Per
015254
948 8.3 Ah
951 8.3 Ah
965 8.1 Ah
966 8.3 Ah
967 8.3 Ah
968 8.3 Ah
969 8.3 Ah
973 8.0 Ah
974 8.1 Ah
975 8.2 Ah

U Per
015254
976 8.3 Pt
981 8.6 Bw
984 8.5 B

S Ari
015912
935 11.9 Lg
969 14.4 L

R Ari
021024
948 10.1 Ah
951 9.9 Ah
951 9.6 Ch
954 9.2 Ma
955 9.0 L
956 9.4 Ah
962 9.0 L
965 9.0 Ah
966 8.9 Ah
967 8.9 Ah
967 8.5 Fd
968 8.8 Ah
969 8.9 Ah
973 8.9 Ah
974 8.9 Ah
975 8.9 Ah
975 8.8 L
976 9.1 Pt
979 8.9 Fd
981 9.0 Ma
984 8.9 B

W And
021143a
951[13.1 Ch
976 13.4 Pt

T Per
021258
937 8.5 Lg
966 8.9 BL
967 9.0 BL
967 8.7 Ah
970 8.8 BL
972 8.8 BL
974 8.6 Ah
975 8.7 BL
976 8.7 BL
976 8.3 Pt
980 8.6 BL
981 8.4 BL
984 8.3 BL
986 8.4 BL
993 8.6 BL
995 8.5 BL

Z Cep
021281
965 11.5 L
966 11.2 Ch
980 10.6 Pt

VARIABLE STAR OBSERVATIONS RECEIVED DURING JANUARY, 1930.

J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.
o CET			RR PER			R HOR			U ERI			T CAM			V TAU		
021403			022150			*025050*			*034625*			043065			044617		
947	8.6	Tf	976	13.0	Pt	963	11.4	Dr	939	14.0	Dr	971	11.8	L	951	9.0	Ch
948	8.7	Ah	976	13.0	L	T HOR			973	14.0	L	972	12.0	BL	972	9.8	B
951	8.9	Ah	R FOR			*025751*			T ERI			976	12.1	BL	976	10.2	Pt
951	8.0	Tf	*022426*			931	9.7	Bl	*035124*			976	12.1	Pt	984	11.1	B
951	8.6	Ch	931	9.8	Bl	938	10.5	Ht	940	7.8	Dr	980	12.0	BL	R ORI		
955	8.6	L	942	10.2	Bl	940	10.6	Dr	950	7.8	Dr	981	12.1	BL	045307		
962	8.8	L	U CET			942	10.7	Bl	956	8.6	Dr	984	12.3	BL	951	10.0	Ch
966	9.0	BL	*022813*			946	10.8	Ht	965	8.7	Dr	995	12.5	BL	955	9.6	L
966	9.1	Ah	951	7.8	Ch	950	11.2	Dr	W ERI			RX TAU			962	9.5	L
967	9.1	Ah	976	7.5	Pt	965	12.5	Dr	*010725*			043208			973	9.6	L
968	9.1	Ah	981	7.8	Gy	U ARI			950	11.1	Dr	951	12.1	Ch	973	9.8	B
969	9.2	Ah	RR CEP			030514			956	10.3	Dr	955	11.9	L	984	10.0	B
970	9.2	BL	022980			895	12.2	Nz	965	9.2	Dr	971	12.5	L	R LEP		
971	7.9	Jo	950	10.8	L	916	13.2	Nz	R TAU			972	12.8	B	*045514*		
972	9.2	BL	963	10.4	L	940	14.1	Nz	042209			976	12.9	Pt	945	7.0	Ch
973	9.1	Ah	966	11.0	Ch	946	14.2	Nz	895	8.7	Nz	R RET			951	5.7	Tf
974	9.2	Ah	971	10.9	Br	951	13.5	Ch	916	9.8	Nz	*043263*			955	6.4	L
975	9.1	Ah	980	11.9	Pt	971	15.0	Nz	940	10.6	Nz	931	12.0	Bl	962	6.0	L
975	8.8	Gs	R TRI			975	15.0	Nz	946	10.6	Nz	938	12.5	Ht	963	5.7	Tf
975	8.8	L	023133			977	14.5	L	951	10.7	Ch	939	13.6	Dr	967	5.7	Tf
976	9.1	Pt	948	8.3	Ah	X CET			965	11.4	Nz	942	12.5	Bl	971	6.7	Jo
976	8.0	Jo	951	8.2	Ah	*031401*			969	11.6	Nz	946	12.5	Ht	973	7.7	Sb
976	9.3	BL	951	8.0	Ch	937	8.2	Lg	971	12.0	Nz	X CAM			973	6.6	L
977	9.4	Wd	952	8.3	Tf	951	8.5	Ch	972	11.8	B	043274			975	6.0	Tf
981	9.3	Ma	956	7.9	Tf	955	8.8	L	975	12.2	Nz	957	8.2	L	976	6.8	Jo
981	9.3	BL	956	8.0	Ah	962	9.0	L	976	12.0	Pt	966	7.8	Ch	976	6.0	Pt
982	9.1	Ku	960	7.5	Tf	966	9.2	Sf	984	12.1	B	971	7.6	L	981	7.0	Ma
984	9.3	BL	963	7.3	Tf	975	9.2	L	W TAU			974	7.6	B	V ORI		
986	9.2	BL	965	7.1	Ah	976	9.3	Pt	042215			976	7.8	Pt	050003		
993	9.1	BL	966	7.2	Ah	980	9.4	Sf	947	9.4	Lg	R DOR			916	14.2	Nz
995	9.3	BL	966	7.3	Ma	981	9.5	B	951	9.2	Ch	*043562*			932	12.8	Lg
S PER			966	6.7	Sf	Y PER			955	10.0	L	931	5.5	Bl	940	13.1	Nz
021558			967	7.3	Tf	032043			962	10.1	L	938	5.5	Ht	946	12.8	Nz
937	9.0	Lg	967	7.2	Ah	939	9.6	Lg	971	10.5	Jo	939	5.0	Dr	951	12.1	Ch
966	9.5	BL	968	7.0	Ah	966	9.3	Ch	972	12.0	B	942	5.4	Bl	955	11.6	L
967	9.3	BL	969	7.0	Ah	966	9.3	BL	974	10.6	L	946	5.5	Ht	962	11.2	L
967	9.5	Ah	973	6.8	Ah	967	9.3	BL	975	10.4	Gs	949	5.0	Dr	969	11.1	Nz
970	9.3	BL	974	6.9	Ah	970	9.3	BL	976	10.9	Pt	967	5.2	Dr	971	10.9	B
972	9.7	BL	975	6.8	Ah	972	9.2	BL	976	10.8	Jo	R CAE			972	11.2	Nz
974	9.6	Ah	976	6.0	Pt	976	9.1	BL	977	10.4	Al	*043738*			973	10.8	L
975	10.0	BL	977	6.5	Wd	976	8.2	Pt	982	10.4	Al	931	10.3	Bl	975	11.0	Nz
976	10.0	BL	981	5.9	Gy	981	9.1	BL	984	10.9	B	939	10.7	Dr	976	10.3	Pt
976	9.5	Pt	981	5.8	Ma	982	9.1	BL	993	12.1	Lg	942	11.0	Bl	984	10.1	B
980	9.7	BL	981	6.0	Sf	984	8.8	BL	S TAU			944	11.2	Ht	993	9.1	Lg
981	9.4	BL	984	7.1	B	986	8.6	BL	042309			950	10.9	Dr	T LEP		
984	9.5	BL	W PER			993	8.7	BL	895	13.4	Nz	965	11.1	Dr	*050022*		
984	9.4	B	024356			995	8.8	BL	916	14.2	Nz	R PIC			910	10.6	Nz
986	9.7	BL	966	10.2	Ch	R PER			940	14.5	Nz	*044349*			931	9.6	Bl
993	9.5	BL	976	9.5	Pt	032335			946	15.1	Nz	931	7.4	Bl	940	9.8	Nz
995	9.4	BL	R HOR			951	13.3	Ch	965	14.3	Nz	940	6.9	Dr	942	9.9	Bl
R CET			*025050*			971	11.6	Br	971	14.3	Nz	942	6.8	Bl	946	9.5	Nz
022000			931	12.4	Bl	975	10.4	Gs	975	14.3	Nz	944	7.3	Ht	972	8.7	Nz
951	13.0	Ch	938	12.6	Ht	976	11.0	L	T CAM			950	6.8	Dr	976	8.9	Pt
974	11.2	L	939	12.1	Dr	T FOR			043065			956	6.9	Dr	981	8.7	B
RR PER			942	12.4	Bl	*032528*			957	11.0	L	965	6.9	Dr	S PIC		
022150			946	12.4	Ht	955	8.7	L	966	11.5	BL	V TAU			*050848*		
955	12.3	L	947	11.6	Dr	962	8.7	L	967	11.7	BL	044617			931	7.5	Bl
971	12.8	Br	949	12.0	Dr	974	8.5	L	970	12.0	BL	932	8.6	Lg	940	8.0	Dr

VARIABLE STAR OBSERVATIONS RECEIVED DURING JANUARY, 1930.

J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.
S PIC			S ORI			AN ORI			RR TAU			SU TAU			U ORI		
050848			*052404*			*053005t*			053326			054319			054920a		
942	8.1	Bl	976	13.0	Pt	974	11.6	L	974	13.2	L	981	9.6	Pt	967	7.6	Ah
944	8.5	Ht	981	12.8	Ma	975	11.7	L	975	13.2	L	981	9.4	Ma	968	7.5	Ah
950	8.3	Dr	982	12.3	Al	976	11.6	L	975	12.7	Nz	982	9.6	Pt	969	7.7	Ah
956	8.5	Dr	984	12.2	B	S CAM			976	12.6	L	S COL			971	8.0	Jo
965	9.0	Dr	T ORI			053068			977	12.7	Nz	*054331*			971	7.1	B
R AUR			*053005a*			966	8.6	BL	RU AUR			931	10.3	Bl	973	7.8	Ah
050953			947	10.2	L	972	8.5	BL	053337			939	10.8	Dr	974	7.7	Ah
965	13.4	Ch	948	10.1	L	976	8.5	BL	965[	13.4	Ch	942	10.9	Bl	975	7.8	Ah
971	13.8	Br	949	10.2	L	976	8.5	Pt	976[	12.4	Pt	944	11.0	Ht	976	8.4	Jo
976	13.8	Pt	950	10.0	L	980	8.6	BL	U AUR			950	11.1	Dr	976	7.7	Pt
982	13.2	Al	951	10.0	L	981	8.5	BL	053531			956	11.4	Dr	979	8.0	Fd
T PIC			952	10.0	L	984	8.6	BL	952	13.2	L	965	11.5	Dr	982	6.8	Al
051247			953	10.0	L	986	8.6	BL	965	13.4	Ch	Z TAU			984	7.8	B
939	13.9	Dr	954	10.2	L	993	8.6	BL	970	13.0	L	054615a			V CAM		
942[	13.1	Bl	954	9.9	Ch	995	8.6	BL	972	13.0	B	910	13.0	Nz	054974		
950	13.9	Dr	955	10.2	L	RR TAU			976	12.4	Pt	924	12.8	Nz	958	14.2	L
965	13.4	Dr	956	10.0	L	053326			Y TAU			940	13.2	Nz	971	13.9	L
NOV TAU			957	9.8	L	910	12.2	Nz	053920			946	13.3	Nz	974[	13.7	B
051316			958	9.8	L	940	10.6	Nz	967	7.9	Kl	949	13.4	L	Z AUR		
971	14.0	L	960	10.0	L	946	11.0	Nz	977	8.3	Kl	969	13.3	L	055353		
T COL			961	10.0	L	947	11.9	L	981	8.5	Kl	969	13.0	Nz	965	11.2	Pt
051533			962	10.2	L	947	12.4	L	982	8.5	Kl	972	12.8	Nz	967	11.2	Pt
931	7.8	Bl	963	10.4	L	948	13.6	L	SU TAU			975	12.9	Nz	972	10.9	B
940	8.2	Dr	965	10.9	L	949	13.2	L	054319			977	12.8	Nz	975	11.2	Pt
942	8.4	Bl	965	11.1	Ch	949	12.9	L	947	9.8	Ch	RU TAU			976	11.2	Pt
944	8.4	Ht	966	10.4	L	950	12.4	L	947	9.5	L	054615c			979	11.2	Pt
950	8.5	Dr	967	10.6	L	950	12.0	L	948	9.5	L	910	13.0	Nz	980	11.3	Pt
956	9.0	Dr	969	10.2	L	951	11.8	L	949	9.6	L	924	13.0	Nz	981	11.2	Pt
965	9.6	Dr	970	10.0	L	951	11.8	L	950	9.6	L	940	12.9	Nz	982	11.2	Pt
S AUR			971	10.2	L	952	11.7	L	951	9.5	L	946	12.8	Nz	982	10.9	Al
052034			971	10.4	B	952	11.8	L	952	9.5	L	949	12.2	L	984	10.6	B
955	9.0	Ch	973	10.2	L	953	12.1	L	953	9.7	L	965	11.1	Ch	R OCT		
962	8.3	L	974	10.0	L	954	12.4	L	954	9.6	L	969	11.1	Nz	*055686*		
966	8.8	BL	975	10.0	L	954	12.4	L	955	9.7	L	969	11.3	L	931	11.9	Bl
970	9.1	BL	976	10.0	Pt	955	11.7	L	956	9.6	L	972	10.6	Nz	939	11.9	Dr
972	9.0	BL	977	10.0	L	955	11.9	L	957	9.6	L	975	10.4	Nz	942	12.2	Bl
974	9.1	B	979	10.2	Pt	956	11.7	L	958	9.6	L	977	10.2	Nz	X AUR		
976	8.3	Pt	981	10.5	Pt	957	11.8	L	959	9.5	L	R COL			060450		
976	9.2	BL	981	10.0	Ma	957	11.8	L	960	9.5	L	*054629*			947	10.8	Ch
980	9.2	BL	982	10.0	Pt	958	11.7	L	961	9.6	L	931	9.7	Bl	947	11.2	Lj
981	8.8	BL	984	10.2	B	958	11.8	L	963	9.5	L	939	9.7	Dr	949	11.3	L
984	9.0	BL	993	11.1	Lg	959	11.8	L	964	9.8	Ch	942	9.6	Bl	951	11.4	Lj
986	9.1	BL	AN ORI			960	11.8	L	965	9.6	Pt	944	9.9	Ht	951	11.6	Ch
993	9.2	BL	*053005t*			960	11.9	L	965	9.6	L	956	9.2	Dr	952	11.5	Lj
993	8.0	Lg	947	11.6	L	961	11.7	L	966	9.6	L	965	9.7	Dr	956	11.7	Lj
995	9.2	BL	948	11.7	L	963	12.3	L	967	9.5	L	α ORI			957	12.0	Ch
W AUR			950	11.6	L	965	11.9	L	967	9.6	Pt	054907			958	11.7	L
052036			952	11.7	L	965	11.7	Nz	969	9.5	L	958	0.5	L	966	12.5	Al
962	10.9	L	953	11.7	L	966	11.8	L	970	9.5	L	970	0.4	L	969	12.7	Ch
972	11.7	B	954	11.7	L	967	11.9	L	971	9.5	L	976	0.4	L	970	12.5	Lj
975	11.6	L	955	11.7	L	969	12.6	L	973	9.5	L	U ORI			971	13.0	L
976	11.8	Pt	957	11.6	L	969	13.0	L	973	9.5	B	054920a			975	12.6	Lj
984	12.1	B	962	11.5	L	969	12.6	Nz	974	9.5	L	947	6.8	Ch	976	12.9	Pt
993	12.4	Lg	965	11.6	L	970	13.2	L	975	9.5	L	948	7.0	Ah	978	13.1	B
S ORI			966	11.7	L	971	12.7	L	976	9.6	Pt	951	7.2	Ah	V AUR		
052404			969	11.6	L	972	12.6	Nz	977	9.5	L	956	7.3	Ah	061647		
965	12.3	Ch	971	11.6	L	972	12.8	B	979	9.6	Pt	965	7.4	Ah	957	12.1	L
971	12.0	B	973	11.6	L	973	12.7	L	980	9.6	Pt	966	7.5	Ah	967	12.2	L

VARIABLE STAR OBSERVATIONS RECEIVED DURING JANUARY, 1930.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
V AUR	V CMI	V GEM	W PUP	T CNC	Y DRA
061647	070109	071713	*074241*	085120	093178
978 12.2 B	958 12.2 Ch	987 13.3 Bw	956 9.5 Dr	968 9.4 Ch	968 11.0 Ch
V MON	960 11.8 L	S CMI	965 10.8 Dr	976 8.2 Pt	973 10.6 L
061702	973 12.4 L	072708	T GEM	T PYX	R LMI
949 9.0 Ch	R GEM	951 8.5 Tf	074323	*090031*	093934
976 10.5 Pt	070122a	957 8.7 Ch	957 10.5 Ch	939 [u3 Dr	968[11.6 Ch
AG AUR	948 6.5 Ah	959 8.7 Tf	976 10.0 Pt	942 [u Bl	976 12.7 Pt
062047	951 6.5 Ah	963 8.8 Tf	U PUP	V UMA	RR HYA
949 9.1 L	956 6.7 Ah	967 8.9 Tf	*075612*	090151	*094023*
957 9.4 L	960 6.4 Ch	967 9.5 Fd	951 13.7 L	949 10.6 L	939[13.6 Dr
967 9.3 L	965 7.0 Ah	972 10.2 Fd	968[11.4 Ch	958 10.4 L	948 14.5 L
976 9.2 L	966 7.0 Ah	975 9.4 Tf	R CNC	973 10.6 L	969[14.0 L
U LYN	966 6.5 Al	976 9.2 Pt	081112	W CNC	R LEO
063159	967 6.9 Ah	982 9.9 Al	960 11.5 Ch	090425	094211
978 11.2 B	968 7.1 Ah	T CMI	976 11.0 Pt	949 13.3 L	948 8.8 Ah
R MON	973 7.1 Ah	072811	V CNC	958 13.9 L	951 9.0 Ah
063308	974 7.1 Ah	953 11.1 L	081617	973 13.6 L	951 8.9 Tf
949 10.4 Ch	975 7.1 Ah	958 10.1 Ch	948 12.8 L	RX UMA	956 8.9 Ah
976 11.6 Pt	976 6.5 Pt	960 10.9 L	957 13.1 L	090567	959 9.1 Tf
NOV PIC	977 7.0 Wd	973 11.2 L	968 12.2 Ch	949 11.5 L	967 9.2 Tf
063462	982 6.4 Al	976 11.5 Pt	971 12.4 L	958 11.5 L	967 9.2 Ah
944 8.2 Ht	Z GEM	Z PUP	976 11.9 Pt	973 11.3 L	968 9.3 Ah
S LYN	070122b	*072820b*	RT HYA	RW CAR	968 9.4 Ch
063558	976 7.9 Pt	895 11.4 Nz	*082405*	*091868*	973 9.5 Ah
949 9.9 Ch	TW GEM	898 11.5 Nz	976 7.8 Pt	918 11.8 Ht	974 9.4 Ah
951 9.5 L	070122c	910 11.7 Nz	R CHA	931 12.1 Bl	975 9.5 Ah
957 9.6 L	976 12.6 Pt	924 11.9 Nz	*082476*	939 12.9 Dr	976 8.8 Pt
967 9.4 L	R CMI	940 12.7 Nz	931 10.5 Bl	942 13.4 Bl	979 9.5 Fd
976 9.7 Pt	070310	946 13.4 Nz	942 9.7 Bl	946[12.8 Ht	981 9.2 Ma
981 9.7 B	953 9.2 L	959 13.9 Nz	944 8.8 Ht	949 13.0 Dr	Y HYA
982 9.7 Sf	958 9.8 Ch	969 14.0 Nz	U CNC	Y VEL	*094622*
X GEM	960 9.6 L	973 14.1 Nz	083019	*092551*	968 7.5 Ch
064030	973 9.7 L	977 14.3 Nz	948 14.6 L	918[12.9 Ht	976 6.5 Pt
976 13.8 Bn	R VOL	S VOL	958 13.6 L	939[13.2 Dr	Z VEL
978 13.6 B	*070772*	*073173*	973 12.9 L	942[12.9 Bl	*094953*
Y MON	939 9.8 Dr	939 13.3 Dr	987 11.8 Bw	946[12.9 Ht	918 9.8 Ht
065111	944 10.4 Ht	942 13.5 Bl	X UMA	R CAR	931 10.2 Bl
951 11.4 L	950 9.8 Dr	950 13.4 Dr	083350	*092962*	939 10.2 Dr
953 11.6 L	956 10.0 Dr	956 13.4 Dr	976 10.6 Pt	918 8.4 Ht	942 10.4 Bl
957 12.1 Ch	965 9.8 Dr	U CMI	S HYA	931 7.0 Bl	946 10.1 Ht
967 12.4 L	L_2 PUP	073508	084803	939 6.1 Dr	950 10.4 Dr
X MON	*071044*	953 8.8 L	948 10.0 Ah	942 6.1 Bl	956 10.7 Dr
065208	939 3.7 Dr	960 9.1 L	951 9.8 Ah	946 5.7 Ht	965 11.0 Dr
951 7.5 Tf	943 3.6 Dr	969 9.3 Ch	956 9.8 Ah	947 5.5 Dr	V LEO
953 7.4 L	947 3.5 Dr	973 9.4 L	967 8.8 Ah	956 5.5 Dr	095421
959 7.3 Tf	950 3.6 Dr	976 10.1 Pt	968 8.7 Ah	967 5.1 Dr	968[11.9 Ch
960 7.3 L	956 3.6 Dr	S GEM	968 8.8 Ch	X HYA	976 12.2 Pt
963 7.5 Tf	963 3.8 Dr	073723	973 8.5 Ah	*093014*	RR CAR
967 7.5 Tf	965 3.8 Dr	957 12.8 Ch	974 8.5 Ah	910 12.9 Nz	*095458*
974 7.3 L	RR MON	976 11.6 Pt	975 8.5 Ah	940 12.6 Nz	918 8.0 Ht
R LYN	071201	987 10.1 Bw	976 8.6 Pt	946 12.3 Nz	946 8.0 Ht
065355	953 14.7 L	W PUP	T HYA	959 12.0 Nz	RV CAR
949 10.6 Ch	V GEM	*074241*	*085008*	969 11.8 Nz	*095563*
957 10.8 L	071713	918 8.9 Ht	949 12.6 L	976 10.9 Pt	918[13.1 Ht
971 10.5 L	948 11.2 L	931 8.0 Bl	958 12.3 L	977 11.4 Nz	942[13.1 Bl
978 11.6 B	957 11.2 L	939 8.0 Dr	973 11.9 L	Y DRA	956[13.5 Dr
V CMI	958 11.7 Ch	942 8.5 Bl	976 11.8 Pt	093178	S CAR
070109	971 12.3 L	944 8.9 Ht		949 10.0 L	*100661*
953 11.7 L	976 12.4 Pt	950 9.2 Dr		958 10.3 L	918 6.3 Ht

VARIABLE STAR OBSERVATIONS RECEIVED DURING JANUARY, 1930.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Oba.
S CAR	R UMA	R COM	RS UMA	R HYA	R CEN
100661	103769	*115919*	123459	*132422*	*140959*
931 5.5 Bl	973 8.3 Ah	958[12.5 Ch	959 14.2 Nz	961 4.7 L	963 6.6 Dr
939 5.6 Dr	974 8.4 Ah	SU VIR	976 13.0 Pt	967 4.6 L	967 7.2 Dr
942 5.7 Bl	975 8.4 Ah	120012	977 13.4 Nz	976 5.1 L	U UMI
946 5.8 Ht	976 8.3 Jo	958[12.5 Ch	981 12.8 Ma	976 5.5 Pt	141567
949 5.3 Dr	976 8.1 Pt	976 13.5 Pt	982 12.5 Bn	S VIR	947 11.4 Lj
956 5.3 Dr	979 8.7 Fd	T VIR	S UMA	*132706*	948 11.5 Lj
967 5.3 Dr	981 8 2 Gy	*120905*	123961	957 12.4 Ch	948 11.2 Ah
Z CAR	V HYA	951 12.2 L	936 10.8 Kl	976 12.0 Pt	949 11.8 Lj
101058a	*104620*	960 10.6 L	948 10.6 Ah	RV CEN	951 11.1 Ah
918 11.6 Ht	953 7.3 L	973 10.1 L	949 11.1 Lj	*133155*	964 12.2 Lj
939 10.6 Dr	958 6.6 Ch	976 10.0 Pt	951 10.8 Ah	922 7.5 Bl	967 11.5 Ah
942 10.5 Bl	962 7.0 L	R CRV	959 10.9 Ch	930 7.5 Bl	973 11.5 Ah
946 10.8 Ht	975 7.0 L	*121418*	964 11.4 Lj	T UMI	974 11.6 Ah
950 10.5 Dr	976 6.5 Pt	940 7.3 Nz	966 11.2 Ma	133273	975 11.5 Ah
956 10.4 Dr	W LEO	946 7.4 Nz	967 11.3 Ah	953 14.1 L	975 12.2 Lj
965 10.4 Dr	104814	948 7.2 L	973 11.4 Ah	T CEN	976 12.5 Pt
AF CAR	910 12.0 Nz	957 6.9 L	974 11.6 Ah	*133633*	S BOO
101058b	940 12.4 Nz	959 6.9 Nz	975 11.6 Ah	956 6.0 Dr	141954
939 10.9 Dr	946 12.7 Nz	966 6.9 L	975 11.6 Lj	RT CEN	951 10.2 L
950 11.1 Dr	951 12.7 L	973 7.4 Nz	976 11.6 Pt	*134236*	960 9.6 Ch
956 11.5 Dr	958 13.5 Ch	976 7.0 Pt	981 11.3 Ma	956 9.4 Dr	962 9.7 L
965 11.1 Dr	959 12.7 Nz	977 7.6 Nz	RU VIR	R CVN	975 9.1 L
W VEL	969 13.7 L	SS VIR	124204	134440	976 8.6 Pt
101153	977 13.3 Nz	122001	948 9.0 L	959 11.6 Ch	RS VIR
918[12.0 Ht	S LEO	948 7.9 L	958 9.8 L	976 11.4 Pt	142205
939 13.4 Dr	110506	958 8.0 L	966 9.0 L	RX CEN	950 8.2 L
942 13.2 Bl	947 11.4 L	966 7.8 L	976 9.0 Pt	*134536*	959 8.1 Tf
956 13.2 Dr	957 11.1 L	T CVN	U VIR	956[13.1 Dr	959 8.1 Nz
U HYA	958 10.8 Ch	122532	124606	T APS	960 8.4 L
103212	966 11.5 L	976 9.5 Pt	948 8.4 L	*134677*	968 8.4 L
948 5.0 L	976 11.6 Pt	Y VIR	958 8.3 L	922 10.2 Bl	977 9.1 Nz
953 5.1 L	RY CAR	*122803*	969 8.9 L	930 9.0 Bl	V BOO
960 5.3 L	*111561*	940 9.4 Nz	976 8.7 Pt	939 9.4 Bl	142539a
975 5.1 L	942[13.1 Bl	946 9.2 Nz	RV VIR	946 10.0 Ht	960 8.6 Ch
RZ CAR	946[13.1 Ht	948 9.6 L	*130212*	956 9.6 Dr	976 8.0 Pt
103270	RS CEN	958 9.7 L	951 10.6 L	RR VIR	R CAM
918 11.8 Ht	*111661*	959 10.0 Nz	958 10.6 L	*135008*	142584
939 10.2 Dr	939 13.1 Dr	959 10.2 Ch	969 11.0 L	976 12.4 Pt	976 8.6 Gb
946 10.2 Ht	942 13.1 Bl	966 10.3 L	U OCT	Z BOO	982 8.7 Ku
950 10.3 Dr	946 13.0 Ht	977 11.1 Nz	*131283*	140113	R BOO
956 10.6 Dr	956 12.6 Dr	981 11.4 Ma	922 11.5 Bl	953 11.8 L	143227
R UMA	965 12.2 Dr	U CEN	930 11.6 Bl	966 11.8 L	947 7.9 Lj
103769	X CEN	*123851*	939 12.4 Dr	Z VIR	949 7.4 Lj
948 8.2 Ah	*111411*	940 12.2 Dr	942 12.9 Bl	*140512*	960 7.4 Ch
951 8.2 Ah	939 8.7 Dr	956 13.0 Dr	944 12.6 Ht	950 10.7 L	964 7.4 Lj
951 8.2 Tf	940 8.8 Dr	T UMA	956 13.2 Dr	958 10.7 L	975 7.5 Lj
956 8.2 Ah	956 9.1 Dr	123160	V VIR	969 10.8 L	976 7.0 Pt
959 8.2 Tf	967 9.8 Dr	936 9.8 Kl	*132302*	976 10.8 Pt	V LIB
964 8.1 Tf	AD CEN	948 10.8 Ah	948 11.9 L	RU HYA	*143117*
965 8.2 Ah	*114858*	951 11.1 Ah	958 10.8 L	*140528*	953 9.6 L
966 8.2 Ah	946 9.3 Ht	959 11.2 Ch	969 10.0 L	956 9.7 Dr	960 10.0 L
967 8.3 Ah	W CEN	966 11.7 Ma	R HYA	R CEN	972 10.5 L
967 8.0 Tf	*115058*	976 12.5 Pt	*132422*	*140959*	Y LUP
967 8.0 Fd	931 11.0 Bl	981[12.8 Ma	947 4.5 Ch	922 5.8 Bl	*145251*
968 8.0 Ch	939 12.2 Dr	R VIR	948 4.7 L	930 5.8 Bl	922 9.7 Bl
968 8.4 Ah	942 12.5 Bl	123307	953 4.5 L	939 6.0 Bl	930 10.0 Bl
969 8.2 Ah	946 12.8 Ht	976 6.8 Pt	957 4.6 Ch	940 6 5 Dr	940 10.7 Dr
971 8.1 Jo	956 12.8 Dr	981 7.0 Ma	959 4.6 Tf	956 6.8 Dr	956 11.2 Dr

VARIABLE STAR OBSERVATIONS RECEIVED DURING JANUARY, 1930.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
S APS	S UMI	Z CRB	RR SCO	V DRA	R SCT
145971	153378	155229	*165030a*	175654	*184205*
922 10.9 Bl	975 9.7 Ah	953 11.0 L	922 7.1 Bl	952|13.1 L	963 5.1 L
930 10.7 Bl	975 10.3 Lj	969 11.4 L	930 7.7 Bl	R PAV	963 5.4 Tf
939 10.8 Bl	976 9.4 Pt	U SER	SS OPH	*180363*	965 5.9 Pt
940 11.3 Dr	R CRB	160210	*165202*	938 9.8 Ht	969 5.0 L
950 11.2 Dr	154428	976 12.0 Pt	976 9.5 Pt	946 10.4 Ht	NOV AQL
956 11.1 Dr	946 6.2 Ch	SX HER	RT SCO	965 11.1 Dr	184300
965 11.2 Dr	947 6.2 Lj	160325	*165636*	T HER	950 10.7 Ch
T LIB	947 6.0 L	949 8.6 L	922 12.5 Bl	180531	965 11.6 Pt
150519	948 6.0 L	957 8.6 L	— DRA	949 11.5 L	RX LYR
967|12.8 L	948 6.2 Lj	971 8.3 L	165752	958 10.8 L	185032
Y LIB	949 6.0 L	975 8.0 Pt	952 11.3 L	W DRA	947 12.7 Ch
150605	951 6.0 L	976 7.9 Pt	975 12.4 L	180565	949 12.8 L
976 14.0 Pt	951 6.2 Lj	980 8.0 Pt	RT HER	952 13.5 L	958 12.1 L
976 13.5 L	953 6.0 L	RU HER	170627	964 14.1 L	965 12.8 Pt
S LIB	954 6.0 L	160625a	980 10.0 Pt	X DRA	S CRA
151520	955 6.0 L	949 9.0 L	RW SCO	180666	*185437a*
967 11.4 L	956 6.0 Ch	957 9.5 L	*170833*	952 12.6 L	918 12.1 En
S SER	957 6.0 L	971 9.8 L	922 11.1 Bl	964 13.5 L	923 12.3 Bl
151714	958 5.9 L	976 10 5 Pt	930 11.0 Bl	W LYR	936 12.0 En
948 11.8 L	959 5.7 Tf	R SCO	Z OPH	181136	940 12.1 Bl
960 11.9 L	960 6.0 L	*161122a*	171401	949 8.1 L	R CRA
960 11.7 Ch	961 5.9 L	977|14.3 Nz	976 8.9 Pt	958 8.1 L	*185537a*
969 12.1 L	962 6.0 L	S SCO	RS HER	965 7.6 Pt	918 12.0 En
S CRB	963 6.0 L	*161122b*	171723	966 8.0 Sf	923 13,0 Bl
151731	964 6.0 Lj	977 10.6 Nz	980 11.6 Pt	975 7.7 L	936|12.5 En
960 8.6 Ch	967 6.0 L	V OPH	S OCT	RV SGR	940 13.0 Bl
976 8.6 Pt	969 6.0 L	*162112*	*172486*	*182133*	T CRA
RS LIB	969 6.2 Lj	976 7.5 Pt	922 12.0 Bl	922 13.1 Bl	*185537b*
151822	971 6.0 L	U HER	930 11.2 Bl	940 13.0 Bl	918|12.5 En
967 10 6 L	972 6.0 L	162119	939 10.5 Bl	SV DRA	923|13.0 Bl
RU LIB	975 6.0 L	976 8.4 Pt	939 10.8 Dr	183149	936|12.5 En
152714	975 6.2 Lj	SS HER	943 10.4 En	952 14.2 L	940 13.3 Bl
976 12.0 Pt	975 6.2 Pt	162807	944 10.5 Ht	964 13.9 L	Z LYR
976|12.5 L	976 6.1 Pt	960 10.4 L	950 9.6 Dr	RZ HER	185634
R NOR	980 6.2 Pt	971 9.7 L	965 8.6 Dr	183225	949 10.5 L
152840	981 6.1 Pt	976 9.5 Pt	RU SCO	949|14.1 L	950 11.0 Ch
922 7.4 Bl	986 6.1 Pt	W HER	*173543*	X OPH	958 10.9 L
930 7.6 Bl	X CRB	163137	922 9.2 Bl	183308	965 12.0 Pt
956 9.1 Dr	154536	976 10.0 Pt	930 9.1 Bl	949 8.5 L	RT LYR
S UMI	953 13.2 L	R DRA	939 9.4 Bl	950 8.2 Ch	185737
153378	960|12.6 Ch	163266	SV SCO	958 8.5 L	947 13.2 Ch
947 9.4 Lj	969|12.9 L	948 12.2 Lj	*174135*	RS DRA	949 12.5 L
948 8.9 Ah	R SER	951 12.2 Lj	922 12.7 Bl	184074	958 12.0 L
948 9.4 Lj	154615	975 12.4 Lj	940 11.4 Bl	949 9.0 Ch	R AQL
951 9.5 Lj	960 7.0 Ch	976 11.9 Pt	W PAV	RY LYR	190108
951 8.9 Ah	976 6.7 Pt	RR OPH	*174162*	184134	948 7.1 Ah
956 9.0 Ah	V CRB	*161310*	922 8.8 Bl	947|13.3 Ch	950 9.6 Ch
956 8.8 Ch	154639	894 9.6 Nz	931 8.5 Bl	952 14.2 L	951 7.3 Ah
959 9.7 Lj	960 7.9 Ch	908 9.3 Nz	938 8.7 Ht	R SCT	956 7.3 Ah
964 9.7 Lj	975 8.2 Pt	S HER	939 8.4 Bl	*181305*	965 7.5 Ah
965 9.1 Ah	R LIB	164715	946 8.6 Ht	947 5.5 Ch	965 8.9 Pt
966 9 4 Ah	*154715*	976 11.5 Pt	965 9.0 Dr	948 5.0 Lj	966 7.4 Ah
966 9.5 Sf	976|12.0 L	RS SCO	RY HER	949 5 0 L	967 7.5 Ah
967 9.5 Ah	RR LIB	*164844*	175519	951 4.9 Lj	968 7.4 Ah
968 9.5 Ah	*155018*	922 9.6 Bl	949 8.9 L	956 5.0 Lj	969 7.4 Ah
969 9.5 Ah	976 12.0 Pt	930 9.9 Bl	958 9.1 L	956 5.0 Tf	973 7.2 Ah
973 9.5 Ah	976 12.3 L	940 10.1 Bl	980 10.4 Pt	957 5.2 L	975 7.6 Ah
974 9.6 Ah				958 5.1 Lj	

VARIABLE STAR OBSERVATIONS RECEIVED DURING JANUARY, 1930.

J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs.

V LYR
190529a
947[13.3 Ch
RX SGR
190818
941[11.8 En
RW SGR
190819a
918 9.5 En
941 9.4 En
S LYR
190925
947[13.3 Ch
949 13.8 L
X LYR
190926
965 8.9 Pt
RS LYR
190933a
947[14.0 Ch
952 14.2 L
RU LYR
190941
952 11.9 L
U DRA
190967
948 9.3 Ch
952 9.6 L
965 9.8 Pt
975 10.3 L
T SGR
191017
950 7.9 L
R SGR
191019
918 8.6 En
941 8.4 En
949 8.1 L
RY SGR
191033
918 6.5 En
923 6.0 Bl
931 5.7 Bl
936 6.5 En
938 6.5 Ht
940 6.0 Bl
948 6.7 L
949 6.9 L
950 6.8 L
TY SGR
191124
940 12.4 Bl
S SGR
191319a
918[11.8 En
923 11.3 Bl
931 10.4 Bl
940 10.0 Bl
941 9.7 En
950 9.8 L

SW SGR
191331
923 10.1 Bl
931 10.6 Bl
940 10.7 Bl
TZ CYG
191350
965 11.1 Pt
U LYR
191637
965 10.7 Pt
TY CYG
192928
947[13.0 Ch
RT AQL
193311
950 11.3 Ch
951 11.0 L
963 11.4 L
965 11.8 Pt
975 12.2 L
R CYG
193449
965 12.5 Pt
RV AQL
193509
951 11.9 L
963 11.5 L
965 11.9 Pt
975 10.4 L
T PAV
193972
923 13.1 Bl
938 12.6 Ht
940 12.2 Bl
941 11.9 En
946 12.3 Ht
947 11.6 Dr
965 9.7 Dr
RT CYG
194048
946 6.7 Ch
948 7.3 Ah
951 7.4 Ah
956 7.5 Ah
965 7.8 Ah
965 7.3 Pt
966 7.7 Ah
967 7.9 Ah
968 7.8 Ah
969 8.0 Ah
971 7.7 Jo
973 7.8 Ah
975 8.0 Ah
976 7.9 Jo
979 8.2 Fd
TU CYG
194348
946 11.6 Ch
954 11.8 L

TU CYG
194348
965 13.0 L
965 12.5 Pt
X AQL
194604
951 10.8 L
963 11.4 L
965 12.2 Pt
975 11.7 L
χ CYG
194632
947 11.3 Ch
965 11.8 Ch
965 11.8 Pt
S PAV
194659
941 9.0 En
965 8.7 Dr
RR SGR
194929
923 13.1 Bl
940[13.2 Bl
RU SGR
195142
923 12.2 Bl
938 12.3 Ht
940 12.5 Bl
946 13.0 Ht
950 12.5 Dr
RR AQL
195202
951 9.1 L
963 9.2 L
975 9.4 L
NOV CYG
195553
947[13.2 Ch
965[12.2 Pt
976[12.2 Pt
RR TEL
195656
938[12.6 Ht
946[12.6 Ht
Z CYG
195849
954 13.2 L
965 12.7 Pt
S TEL
195855
923 13.1 Bl
938 12.8 Ht
940 13.1 Bl
946 12.8 Ht
SY AQL
200212
950 9.6 Ch
952 9.5 L
963 9.5 L
965 9.9 Pt

SY AQL
200212
975 9.8 L
BU CYG
200250
947 11.7 Lj
950 11.6 Lj
951 11.5 Lj
954 11.5 Lj
956 11.3 Lj
958 11.1 Lj
965 10.9 Lj
968 10.7 Lj
970 10.8 Lj
975 10.7 Lj
S CYG
200357
947 12.8 Ch
954 12.4 L
975 12.5 L
R CAP
200514
950 11.5 Ch
950 11.4 L
964 11.9 L
S AQL
200715a
965 9.5 Pt
RW AQL
200715b
965 9.1 Pt
R TEL
200747
923 12.0 Bl
931 12.0 Bl
940 12.0 Bl
940 12.5 Dr
RU AQL
200812
950 9.9 Ch
952 9.6 L
963 9.0 L
975 9.3 L
W CAP
200822
923[12.8 Bl
940 11.8 Bl
Z AQL
200906
886 9.5 Nz
894 9.7 Nz
908 12.3 Nz
912 12.6 Nz
918 12.9 Nz
927 13.4 Nz
932 13.5 Nz
936 13.5 Nz
943 14.3 Nz
950 14.9 Nz
964[14.7 Nz

RS CYG
200938
945 7.0 Ch
949 6.9 Ch
952 7.2 Bc
954 7.3 L
964 6.8 Ch
965 7.3 Pt
971 7.2 Jo
973 7.0 Gb
975 7.4 L
976 7.2 Gb
977 7.0 Jo
977 7.2 Al
977 7.1 Wd
982 7.3 Sr
R DEL
201008
950 13.0 L
975 12.8 L
SX CYG
201130
954 13.0 L
965 11.8 Pt
965 11.9 Ch
975 10.4 L
RT SGR
201139
923 8.0 Bl
931 8.2 Bl
940 8.6 Bl
965 10.3 Dr
WX CYG
201437b
947 12.1 Ch
954 12.1 L
965 12.0 Pt
975 11.8 L
U CYG
201647
948 8.6 Ah
951 8.8 Ah
965 8.3 Ch
965 8.4 Pt
966 9.5 Sf
971 8.3 Jo
976 8.5 Gb
977 8.2 Al
977 8.5 Jo
977 9.8 Wd
979 8.9 Fd
981 10.0 Sf
982 9.4 Sr
U MIC
202240
923 12.6 Bl
940 13.2 Bl
950 12.8 Dr

RU CAP
202622
886 14.6 Nz
894[14.5 Nz
908 14.5 Nz
912 14.7 Nz
918 14.9 Nz
927[14.1 Nz
932[14.1 Nz
936 14.7 Nz
943 14.7 Nz
Z DEL
202817
950 11.1 L
963 11.7 L
975 12.9 L
977 12.5 Pt
ST CYG
202954
954 14.3 L
977 13.6 Pt
V VUL
203226
977 8.7 Pt
R MIC
203429
940 13.2 Bl
Y DEL
203611
952 13.8 L
975[13.1 L
S DEL
203816
945 9.2 Ch
947 10.0 Lj
950 10.1 Lj
951 10.4 Lj
954 10.5 Lj
958 10.5 Lj
965 10.5 Lj
970 10.5 Lj
975 10.6 Lj
981 11.0 Pt
V CYG
203847
954 11.6 L
965 11.2 Ch
977 12.5 Pt
980 11.9 Ma
Y AQR
203905
886 10.1 Nz
894 10.0 Nz
908 9.8 Nz
912 9.7 Nz
918 9.5 Nz
927 10.0 Nz
932 10.1 Nz
936 10.3 Nz
943 10.4 Nz

VARIABLE STAR OBSERVATIONS RECEIVED DURING JANUARY, 1930.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
Y AQR	R VUL	T CEP	RU CYG	RS PEG	T TUC
203005	205923a	210868	213753	220714	*223462*
950 10.4 Nz	946 9.2 Ch	973 6.6 Ah	974 7.8 Ah	896 12.4 Nz	956 9.4 Dr
950 10.8 Ch	951 9.8 Ah	973 6.5 Sb	975 7.8 Ah	910 12.3 Nz	965 9.9 Dr
964 10.4 Nz	972 12.0 B	974 6.6 Ah	981 7.2 Pt	913 12.4 Nz	R LAC
981 11.5 Pt	981 12.5 Pt	975 6.6 Ah	RV CYG	918 12.5 Nz	223841
T DEL	V CAP	976 6.7 Sb	213937	927 13.1 Nz	952 9.5 L
204016	*210121*	977 6.5 Wd	981 6.3 Pt	932 13.2 Nz	960 10.2 L
950 13.3 L	940[13.0 Bl	977 6.2 Jo	RR PEG	936 13.3 Nz	966 10.4 Sf
972 13.4 B	TW CYG	977 6.5 Pt	214024	943 13.3 Nz	974 10.4 L
975 13.7 L	210129	979 6.5 Fd	974 12.1 B	950 13.8 Nz	981 11.0 Pt
981 13.5 Pt	954 14.4 L	RR AQR	981 11.5 Pt	951 13.2 L	RW PEG
V AQR	965[13.5 Ch	*210903*	R GRU	964 13.9 Nz	225914
204102	X CAP	951 14.3 L	*214247*	969 13.2 L	896 9.6 Nz
951 8.4 L	*210221*	964 14.2 L	940 13.5 Bl	971 13.8 B	910 9.6 Nz
964 8.4 L	931 12.1 Bl	Y PAV	946 13.1 Ht	972 14.3 Nz	913 10.1 Nz
975 8.9 L	940 13.0 Bl	*211570*	947 13.5 Dr	977 14.2 Nz	918 10.0 Nz
W AQR	X CEP	938 5.8 Ht	965 12.8 Dr	R PSA	927 10.7 Nz
204104	210382	946 5.8 Ht	V PEG	*221230*	936 10.8 Nz
886 12.0 Nz	948[11.4 Ch	X PEG	215605	940 10.0 Dr	941 11.7 Nz
894 12.3 Nz	977[13.6 B	211614	969 14.3 L	956 12.0 Dr	943 11.7 Nz
908 13.2 Nz	RS AQR	974 10.0 B	971[14.0 B	965 12.5 Dr	945 11.7 Ch
912 13.0 Nz	*210504*	981 9.8 B	U AQR	X AQR	950 12.0 Nz
918 13.2 Nz	951 13.3 L	981 10.1 Pt	*215717*	*221321*	951 12.1 L
927 13.6 Nz	964 13.9 L	T CAP	969 12.8 L	910 12.9 Nz	960 13.1 L
936 13.5 Nz	Z CEP	*211615*	RT PEG	918 13.2 Nz	964 13.2 Nz
943 13.8 Nz	*210516*	940[13.2 Bl	215934	927 13.3 Nz	971 13.6 Nz
950 13.9 Nz	908 13.1 Nz	951[14.1 L	951 12.2 L	932 13.3 Nz	971 13.8 B
951 13.9 L	912 13.4 Nz	964[12.8 L	963 10.9 L	941 13.5 Nz	975 13.9 Nz
964 13.8 L	918 14.2 Nz	S MIC	973 10.3 L	950 13.6 Nz	977 13.9 Nz
964 14.2 Nz	927[13.4 Nz	*212030*	RY PEG	964 13.8 Nz	981 14.2 Pt
975 13.9 L	943 14.7 Nz	940 13.4 Bl	220133a	972 14.2 Nz	R PEG
U CAP	950 14.8 Nz	Y CAP	971 13.3 B	S GRU	230110
204215	R EQU	*212814*	RZ PEG	*221048*	976 9.9 Gb
940 11.9 Bl	210812	940[13.1 Bl	220133b	946[12.8 Ht	V CAS
951 11.3 L	910[14.1 Nz	951[14.3 L	951 9.8 L	949[12.8 En	230759
964 10.8 L	918 15.1 Nz	W CYG	960 9.0 L	RV PEG	973 10.6 B
974 12.2 L	927[14.1 Nz	213244	971 9.2 B	222129	981 10.4 Pt
T AQR	936 14.2 Nz	947 6.0 Tf	974 9.4 L	951 13.7 L	984 10.1 B
204405	943 13.8 Nz	949 6.0 L	981 8.8 Pt	969 13.1 L	W PEG
950 10.7 Ch	950 12.9 Nz	951 6.0 Tf	T PEG	976 12.5 B	231425
981 8.1 Pt	952 12.9 L	955 5.9 L	*220412*	S LAC	945[12.4 Ch
RZ CYG	964 12.0 Nz	963 5.9 L	951 13.7 L	222439	951 12.0 L
204846	972 11.8 Nz	963 6.1 Tf	969 13.4 L	951 12.4 L	960 12.4 L
977 11.6 Pt	975 12.0 L	973 5.7 L	Y PEG	971 13.3 B	974 11.8 L
S IND	977 11.4 Nz	975 6.0 Tf	220613	969 13.4 L	S PEG
204954	981 11.5 Pt	S CEP	886 12.4 Nz	981 13.5 Pt	231508
938[13.1 Ht	T CEP	213678	896 13.0 Nz	R IND	951 13.4 L
940[13.0 Bl	210868	977 11.7 Pt	910 14.3 Nz	222867	969 12.9 L
946[13.1 Ht	948 6.2 Ah	RU CYG	913 14.2 Nz	938 13.5 Ht	981 12.3 Pt
X DEL	948 6.4 Ch	213753	918 14.4 Nz	943 13.0 Bl	V PHE
205017	951 6.2 Ah	948 8.6 Ah	927[13.9 Nz	946 13.0 Ht	*232746*
952 14.2 L	956 6.2 Ah	951 8.3 Ah	936 14.6 Nz	947 12.8 Dr	938 10.3 Ht
972[13.5 B	965 6.4 Ah	956 8.1 Ah	943 15.1 Nz	965 12.0 Dr	940 9.8 Dr
T OCT	966 6.5 Ah	965 8.3 Ah	964 14.8 Nz	T TUC	941 10.0 En
205782	967 6.7 Ah	966 8.0 Ah	972 14.8 Nz	*223462*	946 10.3 Ht
940 9.3 Dr	968 6.7 Ah	967 8.1 Ah	977[14.6 Nz	938 9.2 Ht	949 10.3 Dr
947 9.6 Dr	968 6.6 Gv	968 8.0 Ah	RS PEG	940 8.8 Dr	956 10.6 Dr
956 9.5 Dr	969 6.6 Ah	969 8.0 Ah	220714	946 9.2 Ht	
965 9.4 Dr	971 6.5 Jo	973 7.9 Ah	886 12.5 Nz	950 9.1 Dr	

VARIABLE STAR OBSERVATIONS RECEIVED DURING JANUARY, 1930.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs
Z AND	R AQR	Z CAS	V CET	R CAS	W CET
232848	*233815*	233956	*235209*	235350	*235715*
981 10.1 Pt	931 8.5 Bl	950 10.6 Ch	942[13.6 Bl	965 6.0 Ah	950 9.2 Ch
ST AND	938 8.8 Ht	951 10.5 L	951 14.0 L	966 6.0 Ah	Y CAS
233335	942 8.7 Bl	960 10.5 L	969 13.2 L	967 6.1 Ah	235855
945 11.2 Ch	946 8.6 Ht	974 10.6 L	R TUC	968 6.1 Ah	950 10.6 Ch
947 11.2 Lj	947 8.8 Tf	976 10.5 B	*235265*	968 6.5 Gy	951 11.6 L
950 11.2 Lj	950 8.5 Ch	RR CAS	938[13.0 Ht	973 6.0 Ah	960 11.4 L
951 11.2 Lj	951 8.7 L	235053	947 13.8 Dr	973 6.3 B	974 10.1 L
954 11.3 Lj	952 9.0 Tf	974[13.5 B	965 12.3 Dr	974 6.0 Ah	974 10.2 B
958 11.3 Lj	956 8.9 Tf	976[13.1 Bn	R CAS	975 6.0 Ah	984 10.0 B
968 11.2 Lj	960 8.8 Tf	R PHE	235350	984 6.4 B	SV AND
970 11.1 Lj	960 8.5 L	*235150*	948 6.7 Ah	Z PEG	235939
972 10.7 B	963 8.9 Tf	940 11.9 Dr	950 6.3 Ch	235525	945[12.0 Ch
975 11.0 Lj	975 8.9 Tf	947 11.5 Dr	951 6.6 Ah	951 13.7 L	974 12.9 B
977 11.4 Al	981 8.5 Pt	956 11.4 Dr	956 6.2 Ah	969 13.3 L	981 13.5 Pt
981 10.8 Pt		965 10.9 Dr		974 13.0 Lj	
984 10.7 B				981 13.6 Pt	

RAPIDLY VARYING IRREGULAR VARIABLES.

Star J.D.	Est.Obs.	J.D.	Est.Obs.	Star J.D.	Est.Obs.	J.D.	Est.Obs.
005840 RX ANDROMEDAE—				060547 SS AURIGAE—			
5965.7	[12.4 Pt	5976.7	13.2 Pt	5978.5	12.1 B	5981.5	13.6 B
5971.6	12.6 Br	5982.8	13.0 Pt	5979.7	13.5 Pt	5982.8	[12.6 Pt
010884 RU CEPHEI—				5980.9	[12.6 Pt	5993.6	[13.8 Lg
5950.7	8.6 L	5963.3	8.7 L	074922 U GEMINORUM—			
060547 SS AURIGAE—				5895.5	14.1 Nz	5962.7	[12.4 L
5895.5	14.4 Nz	5965.2	[14.5 L	5898.5	14.2 Nz	5963.7	[10.3 L
5898.5	13.8 Nz	5966.3	[13.9 L	5910.5	14.2 Nz	5965.2	[13.7 Nz
5910.4	14.8 Nz	5967.3	[13.9 L	5924.5	14.0 Nz	5966.7	[13.7 L
5916.5	14.8 Nz	5968.2	12.6 Ch	5940.5	14.1 Nz	5967.7	[13.7 L
5924.4	14.7 Nz	5969.1	10.8 Ch	5946.5	14.1 Nz	5969.2	13.9 Ch
5940.5	14.9 Nz	5969.3	10.7 L	5947.7	[13.7 L	5969.3	14.0 L
5941.7	[12.6 Fr	5969.5	10.8 Nz	5948.6	14.2 L	5969.5	14.4 Nz
5946.5	15.5 Nz	5969.6	10.9 L	5949.4	13.9 L	5970.5	14.0 L
5947.3	[14.5 L	5970.5	11.0 L	5950.7	14.0 L	5971.4	14.1 L
5948.7	[14.5 L	5971.1	11.3 Nz	5951.4	14.0 L	5971.7	13.9 L
5949.4	[14.5 L	5971.4	10.9 L	5951.7	14.0 L	5973.4	14.0 L
5949.7	[14.5 L	5971.6	11.1 Br	5952.3	[13.3 L	5973.4	13.5 Nz
5950.3	[14.5 L	5971.6	11.3 B	5952.7	14.1 L	5974.4	13.9 L
5950.7	[14.8 L	5971.7	11.1 L	5953.7	14.0 L	5975.2	13.9 Nz
5951.4	15.0 L	5972.1	11.0 Nz	5954.7	14.0 L	5975.3	13.8 L
5951.7	14.8 L	5972.5	10.7 B	5955.7	14.0 L	5975.9	13.9 L
5952.3	[14.5 L	5973.4	10.9 Nz	5955.7	14.0 L	5976.7	14.0 L
5952.7	[14.5 L	5973.7	11.0 L	5956.7	[13.7 L	5977.4	14.0 L
5953.6	15.0 L	5973.5	10.7 B	5957.4	13.8 Ch	5977.5	14.1 Nz
5954.4	15.0 L	5973.7	11.0 L	5958.3	[11.7 L	5979.8	[12.4 Pt
5954.7	14.8 L	5974.4	10.8 L	5959.4	14.1 Nz	5980.9	[12.4 Pt
5955.3	[14.5 L	5974.5	11.0 B	5959.6	13.9 L	5981.6	[13.7 B
5955.7	[14.5 L	5975.2	10.9 Nz	5960.7	[13.7 L	5982.8	[13.3 Pt
5956.6	[12.4 L	5975.4	10.7 L	5961.7	[13.3 L	5993.6	13.9 Lg
5957.6	[13.9 L	5975.7	11.0 L	081473 Z CAMELOPARDALIS—			
5958.3	[13.3 L	5975.9	11.2 Pt	5947.3	10.8 L	5953.7	11.9 L
5958.7	[13.9 L	5976.4	10.8 L	5947.7	10.8 L	5954.4	12.5 L
5960.7	[13.3 L	5976.5	11.0 B	5948.2	10.7 L	5954.7	12.2 L
5961.7	[12.4 L	5976.7	11.5 Pt	5949.2	10.8 L	5955.3	12.7 L
5962.7	[12.4 L	5976.7	11.0 L	5950.2	10.8 L	5955.3	12.7 L
5963.3	[12.4 L	5977.4	11.0 L	5950.7	11.4 L	5956.6	12.4 L
5963.7	[11.5 L	5977.4	11.2 Nz	5951.4	11.5 L	5957.3	12.3 L
5964.2	[14.5 L	5977.6	11.7 B	5952.3	11.8 L	5958.3	12.5 L

VARIABLE STAR OBSERVATIONS RECEIVED DURING JANUARY, 1930.

Star	J.D.	Est.	Obs	J.D.	Est.	Obs.
081473 Z CAMELOPARDALIS—						
	5958.7	12.5	L	5967.7	11.0	L
	5959.6	12.5	L	5968.2	10.5	Ch
	5960.4	12.7	L	5969.3	10.8	L
	5960.7	12.5	L	5969.6	11.0	L
	5961.3	12.5	L	5970.5	11.2	L
	5961.7	12.7	L	5971.4	11.2	L
	5962.3	12.7	L	5971.7	11.3	L
	5962.7	12.8	L	5973.4	11.8	L
	5963.3	12.8	L	5973.7	11.5	L
	5964.2	13.0	L	5974.4	12.1	L
	5965.3	12.9	L	5975.3	12.2	L
	5966.3	12.6	L	5975.7	12.0	L
	5966.7	12.0	L	5976.7	12.2	L
	5967.3	11.1	L	5977.4	12.6	L
094512 X LEONIS—						
	5947.7	14.2	L	5960.7	13.8	L
	5948.6	14.2	L	5966.6	12.3	L
	5949.6	14.2	L	5967.7	14.2	L
	5950.7	14.2	L	5969.7	14.2	L
	5951.7	14.2	L	5970.5	14.8	L
	5952.6	14.2	L	5971.6	14.2	L
	5953.6	14.2	L	5972.7	14.2	L
	5954.7	12.5	L	5973.6	14.2	L
	5955.7	12.3	L	5974.4	12.3	L
	5956.6	13.0	L	5975.7	14.2	L
	5957.6	13.8	L	5976.7	14.2	L
	5958.6	13.8	L	5977.4	13.8	L
202946 SZ CYGNI—						
	5965.7	9.0	Pt	5976.7	8.9	Pt
	5967.7	9.3	Pt	5981.7	9.2	Pt
213843 SS CYGNI—						
	5947.1	11.7	Ch	5950.2	11.7	Ch
	5947.2	12.1	Lj	5950.2	12.0	Lj
	5947.4	12.0	L	5950.2	11.7	L
	5948.2	12.0	Lj	5951.2	11.8	Ah
	5948.5	11.9	Ah	5951.2	11.7	Lj
	5949.2	11.9	L	5951.3	12.0	L

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
213843 SS CYGNI—						
	5951.7	11.0	Fr	5972.3	11.6	L
	5952.3	12.1	L	5972.5	10.3	B
	5952.3	12.0	Lj	5972.7	10.4	Bc
	5954.2	12.0	Lj	5973.3	8.8	Ah
	5954.3	12.2	L	5973.4	8.7	L
	5955.3	12.2	L	5973.5	8.6	B
	5956.3	12.0	Lj	5974.3	8.5	L
	5956.5	11.6	Ah	5974.3	8.4	Ah
	5957.2	12.1	L	5974.5	8.5	B
	5958.2	12.1	L	5975.2	8.4	Ah
	5958.3	12.0	Lj	5975.3	8.5	L
	5959.1	11.9	Ch	5975.7	8.5	Bc
	5959.2	12.0	Lj	5976.2	8.3	Lj
	5960.3	12.2	L	5976.5	8.6	B
	5961.3	12.2	L	5976.5	8.4	Fd
	5963.3	12.1	L	5976.6	8.4	Fr
	5964.2	12.0	L	5976.7	8.5	Bc
	5965.2	11.8	Ah	5977.3	7.9	Kl
	5965.2	12.0	Lj	5977.4	8.6	L
	5965.3	12.2	L	5977.5	8.4	B
	5965.7	11.6	Pt	5977.5	8.6	Al
	5966.0	11.6	Ch	5978.5	8.7	B
	5966.2	11.8	Ah	5978.6	8.4	Bc
	5966.3	12.1	L	5979.7	8.7	Fd
	5967.2	11.8	Ah	5980.5	8.4	Sf
	5967.3	12.2	L	5980.5	8.7	Ma
	5967.7	11.7	Pt	5981.2	8.0	Kl
	5968.2	12.0	Lj	5981.5	8.6	B
	5968.3	11.9	Ah	5981.5	8.5	Sf
	5969.2	11.4	L	5981.7	8.9	Pt
	5969.3	11.8	Ah	5982.2	8.5	Kl
	5970.2	11.8	L	5982.5	8.5	Sf
	5970.3	12.0	Lj	5984.5	8.7	Sf
	5971.3	12.0	L	5984.5	9.5	B
	5971.4	11.3	Kl	5986.2	9.8	Kl
	5971.5	11.5	B	5986.5	9.9	Sf
	5971.6	11.6	Bc			

MONTHLY SUMMARY FOR JANUARY, 1930.

Observer	Initial	Vars.	Observations
Ahnert	Ah	25	204
Allen, P. R.	Al	11	13
Baldwin	Bl	80	148
Bigelow	Bw	7	7
Boutell	BL	8	83
Bouton	B	70	105
Brocchi	Br	6	6
Brown, A. N.	Bn	4	5
Buckstaff	Bc	2	6
Chandra	Ch	134	158
Dartayet	Dr	72	181
Ensor	En	14	22
Ford	Fd	9	13
Ferris	Fr	2	2
Gaebler	Gb	3	4
Goodsell	Gs	3	3
Gregory	Gy	6	7
Houghton	Ht	52	80
Jones	Jo	10	20
Kohl	Kl	4	11
Kusel	Ku	2	2
Lacchini	L	175	656
Leiner	Lj	13	77
Logan	Lg	19	23
Marsh	Ma	17	22
Nizamiah Obs.	Nz	34	242
Peltier	Pt	174	208
Smith, F. W.	Sf	9	17
Soberanes	Sb	3	4
Schoechert	Sr	2	2
Taffar	Tf	15	51
Webb	Wd	5	6
Totals		32	407 2388

Z Puppis, one of the most interesting of long-period variables, stands to the credit of Mr. Perry, and in those days the detection of variability in a star by purely visual methods was truly an achievement, particularly at the hands of an amateur. Mr. Perry had been long connected with the Association, being one of the Charter Life Members, and although ill health prevented him from making many actual observations, he had a deep interest in our work. We all sincerely mourn his loss in our ranks.

The cloudy weather usually prevalent at this season of the year is reflected herewith in the smaller size of the report, but even so, the report is larger than for the corresponding month in many previous years. The special stars are being followed very assiduously, and it is hoped that the next maximum of U Geminorum, in particular, will not escape our attention.

Mr. Paul Ahnert, of Wittgensdorf, Germany, submits the following results of some of his recent observations on short-period variables. The variable star BD +10°3800 has the period of 6.14 days; the formula for the computation of maximum being

Max. J.D. $2425845^d.71 + 6^d.14 \cdot E$; Range 8.2 — 8.9; M — m, 2.00; M — m/P 0.33.

These elements were derived from 39 observations made in 1929. The following heliocentric times of minima have been derived by Mr. Ahnert for U Cephei.

J. D. 2425552.4779
5622.2801
5719.5035
5734.4626
5966.3031

These results on U Cephei agree remarkably well with similar determinations published in recent numbers of the Harvard Bulletin.

LEON CAMPBELL, Recording Secretary.

February 12, 1930.

COMET NOTES

By G. VAN BIESBROECK.

The first new comet of this year was found on the evening of February 19 by the enthusiastic variable-star observer L. C. Peltier at Delphos, Ohio. This is the second cometary discovery to the credit of this active amateur astronomer. Mr. Peltier is not equipped for precise measurements of comets so he at once wired to the writer, giving the rough place of the new comet:

Right Ascension $9^h\ 25^m$, Declination $+40°\ 10'$.

With the 6-inch comet-seeker of the Yerkes Observatory the object was readily picked up: it appeared as a large diffuse nebulosity, some 6′ in diameter with a faint central condensation but it did not show any indication of tail. The total magnitude was estimated as equivalent to a 11^M star but this indication was very uncertain on account of the appearance of the object; the nucleus alone was hardly as bright as a 12^M star. I also photographed the object with the 24-inch reflector and the exposures were repeated after a cloudy interval in order to find the daily motion which proved to be extremely rapid. The next morning the results of the measures were wired to the Harvard Observatory as follows:

Comet Peltier Mg. 11 Feb. 20.18054 U.T. $9^h\ 22^m\ 38^s.94$, $+40°\ 21'\ 55''.3$.
Daily motion 13 min. west and 4 degrees north.

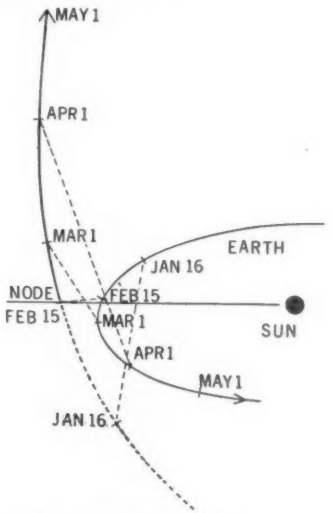
The daily displacement of about 5 degrees made it certain that the comet was relatively near to the earth at that time. Observations were repeated on the following nights and it soon was evident that the brightness was rapidly falling off and that the angular motion was slowing down:

Feb.	21.18050	$9^h\ 9^m\ 19^s.73$	$+44°\ 4'\ 48''.6$	12^M
	22.10112	8 57 28.86	+46 57 54.9	12
	23.15260	8 44 27.36	+49 43 24.8	13

From Harvard College announcement card No. 104 it appears that the comet has been recorded photographically by Schwassmann and Wachmann at Bergedorf (Germany) on a plate exposed one day before Peltier's discovery:

Feb. 18.9371 $9^h\ 39^m\ 40^s.3$ $+34°\ 46'\ 11''$ 10^M

It is not known so far if this is an independent discovery or if it was the announcement by Peltier that led to the examination of the plates.



PATH OF COMET 1930 *a*.

On February 23 the following parabolic elements, computed by L. E. Cunningham from the observations on February 18, 20, and 21 were sent out by the Harvard Observatory.

Perihelion	Jan. 16.26 U.T.
Node	147° 33′
Perihelion to Node	326 6
Inclination	100 5
Perihelion distance	1.095 astr. units

with the following ephemeris:

1930	R.A. h m s	Decl. ° ′	Light
Feb. 24	8 34 20	+51 37	1.00
28	7 52 56	57 31	
Mar. 4	7 21 44	60 32	
8	6 59 08	62 11	0.20

The course of the comet relatively to the earth is illustrated in the diagram. In its northerly motion in a plane nearly at right angles to that of the earth's orbit the comet passed through the node with the ecliptic on February 15 at which time its distance from the earth was only 18 million miles, one-fifth of our distance from the sun. But it was not visible then on account of the full moon. Before that date it must have been visible in the southern hemisphere. But it took the keen eyed observer in Delphos to locate the newcomer shortly after the moonlight no longer interfered. The short ephemeris shows that the comet will remain high up in the northern sky in Camelopardalis, but will lose very rapidly in brightness. At the time of the discovery the moment of nearest distance to the sun was already passed by one month and now the distance from the earth is fast increasing. These two circumstances will shorten the duration of visibility of this inconspicuous comet, which will soon be out of reach even of large instruments.

Except for the very faint COMET 1927*d* (STEARNS) and 1925*i* (SCHWASSMANN-WACHMANN) which are still in reach of powerful instruments, comet Peltier is the only one now visible as far as known. PERIODIC COMET DANIEL 1909 IV should, however, be looked for in the western sky. The Handbook of the British Astronomical Association for 1930 gives the following search ephemeris computed by Mr. F. R. Cripps, who found April 7.516 as the most probable date for the perihelion:

	Perihelion Apr. 4		Perihelion Apr. 12	
	R.A.	Decl.	R.A.	Decl.
	h m	° ′	h m	° ′
Feb. 27	1 43.2	+ 6 1	1 34.0	+ 3 58
Mar. 7	2 2.0	9 14	1 52.4	7 9
15	2 22.4	12 22	2 12.4	10 16
23	2 43.3	15 24	2 32.9	13 18
31	3 5.3	+18 17	2 54.4	+16 14

Williams Bay, Wisconsin, February 24, 1930.

METEOR NOTES

By CHARLES P. OLIVIER.

The annual report of the American Meteor Society is herewith presented to the members. As will be seen the amount of observing done and numbers of meteors recorded have exceeded those of any year since our organization, with the possible exception of 1916. But due to the better organization, and the part taken by experienced observers, the results for 1929 are certainly more valuable. In addition to the observations of ordinary meteors, in 1929 reports on 170 fireballs and isolated bright meteors were sent in. Also the 264 telescopic meteors found in Table III were largely due to trained observers who gave complete data on each object. The wide distribution of our new blank for telescopic meteors has been partly responsible for the additonal value of recent reports. The printing of gnomonic maps for the Southern Hemisphere has also greatly stimulated work there, not only with those who report directly to the A.M.S., but with persons who send their results to other organizations. As the A.M.S. stands for the furtherance of meteoric astronomy everywhere, copies of our maps, blanks, circulars and publications have been cheerfully furnished to foreign organizations, interested in meteoric research. In this way the results of our experience have been made available to everyone, and we are glad to know that our standard

recording blanks are widely copied, and our rules for the determination of radiants used elsewhere.

Some of the outstanding features for 1929 are as follows: The breaking of the record for the Southern Hemisphere by R. A. McIntosh, who observed 1500 meteors, nearly every one of which was carefully plotted. Many radiants resulted from this excellent work by this trained observer. Next the enviable record made by our new member, B. C. Darling, who observed on 120 nights. Only a person who has himself been an observer can appreciate the energy and perseverance required to work so often, frequently when meteors were very scarce. Then the continued valuable contributions made by our large Texas group. Then the reporting of so many telescopic meteors from the Lamont-Hussey and La Plata Observatories, both in the Southern Hemisphere. Thanks to the use of the micrometer, the directions of motion could be very accurately observed. Several members of the A.A.V.S.O. have also most kindly reported the telescopic meteors seen by them, which are hereby gratefully acknowledged. Lastly the numerous and valuable observations on fireballs which have been sent in, often several persons reporting the same object, so that its path could be investigated. All our records were broken by about 450 separate reports on the Illinois fireball of July 25. Thanks to the valuable coöperation of the Hydrographic Office, U.S.N., and the Marine Division of the U. S. Weather Bureau, we receive reports on fireballs from ships at sea. These are growing in numbers and accuracy.

Bound copies of Meteor Notes and other articles on meteors by the writer, which appeared in POPULAR ASTRONOMY in 1929, have been issued as Reprint No. 5, of the Flower Observatory. A copy has been or is being sent to each contributing member of the A.M.S. If anyone has not received his copy, please notify the writer. For general accounts of last year's work members are asked to consult this. Results which depend on intensive mathematical study will appear later, probably in the M series of our publications.

The excellent showing made by the A.M.S. as a whole and by certain members in particular should encourage those who did little or nothing in 1929 to bestir themselves in 1930. If all our members would observe one half night per month, the results would be most surprising—and the members none the worse for the effort! This is suggested as an ideal to our relatively inactive colleagues for the rest of 1930.

Attention is further called to the fact that many members seem to forget that the annual dues are $1. This does not cover the cost of postage and the printing of the circulars, to say nothing of the maps and blanks distributed to everyone. The least an inactive member can do is to pay his dues on the first of the year. The names of persons, who have neither sent in any observations nor paid their dues, will be dropped from our membership and mailing list at the end of this year, if nothing is received from them meantime.

In addition to organizations mentioned, our best thanks go to persons mentioned in Table II, who, though not members, made good observations and kindly reported them to the A.M.S. Also to many, too numerous to mention, who sent in observations of fireballs or occasional meteors. Special acknowledgement is due to Director Harlow Shapley and Dr. W. J. Fisher of Harvard College Observatory, who put at our disposal numerous meteor reports received there. These have appeared in detail in Reprint No. 5. The meteors contained in them do not however, appear in Table II of this paper.

Finally the moon will interfere less this year with the principal showers than it did in 1929. May we not, therefore, expect and hope for an even better report

in 1930, especially as so many new members joined the A.M.S. recently who ought to be eager to contribute their share?

TABLE I.

Name	Station	Nights	Total Meteors	Remarks
Ahern, J. F.	Jacksonville, Fla.	2	5	
Alden, H. L.	Johannesburg, S. Africa	2	54	
Allen, Miss L. B.	Frederick, Md.	2	17	
Anderson, Miss Mary	Swarthmore, Pa.	7	26	
Anyzeski, Vincent	New Haven, Conn.	13	317	Plotted 316
Axtell, R. H.	Lewistown, Maine	4	66	Plotted 13
Bennett, Millard	Ft. Wayne, Ind.	11	174	
Brown, Robert	Ft. Worth, Texas	9	223	Plotted 123
Bunch, Sterling	Ft. Worth, Texas	12	382	Plotted 278
Conboy, J. J.	Lawton, Okla.	11	99	
Darling, B. C.	Lansing, Mich.	120	934	Plotted 926
Fisher, W. J.	Cambridge, Mass.	2	34	
Ford, C. B.	Ann Arbor, Mich.	10	271	
Klapperich, A. J.	Allentown, Pa.	2	4	
Lawrence, A. S.	Merrick, L. I., N. Y.	1	9	
Lawsine, Leo	Malden, Mass.	1	15	
Logan, J. H.	Dallas, Texas	9	183	Plotted 153
McIntosh, R. A.	Auckland, New Zealand	59	1500	Plotted 1472
Marsh, F. F.	Frederick, Md.	4	80	Plotted 68
Merrill, P. W.	Pasadena, Calif.	1	92	Counts
Monnig, O. E.	Ft. Worth, Texas	21	577	Plotted 416
Niebuhr, V. J.	Reedsburg, Wis.	3	39	
O'Hara, R. J.	Ann Arbor, Mich.	1	196	Counts
Olivier, C. P.	Upper Darby, Pa.	3	49	Plotted 40
Olsen, F. C. W.	Chicago, Ill.	4	25	
Ransom, H. B.	Jacksonville, Fla.	3	3	
Sanders, Blakeney	Ft. Worth, Texas	7	185	
Schafer, C. P.	Nashville, Tenn.	13	179	
Shinkfield, R. C.	Adelaide, S. Australia	10	112	Plotted 24
Smith, F. W.	Glen Olden, Pa.	6	33	
Stevens, Miss L. Noble, Miss C. M.	Ft. Worth, Texas	2	48	
Trimmier, Miss M. E.	Chicago, Ill.	3	26	
Watkins, Gerald	Caldwell, Idaho	2	85	
Whitney, B.S.	Beaver, Okla.	5	161	
Wilson, L. J.	Franklin, Ky.	2	34	Plotted 22
VanOsdol, MissVirginia	Ft. Worth, Texas	4	54	
VanZandt, Lycurgus	Ft. Worth, Texas	2	15	
Total		373	6306	

When nothing is said in the *Remarks* it is to be inferred that all or at least the majority of the meteors were plotted. Names of persons working as assistants of members of the A.M.S. appear in this table.

TABLE II.

Name	Station	Nights	Total Meteors	Remarks
Alexander, S.	Yosemite Park, Calif.	1	119	Count
Anderson, Miss A. J.	Ramona, Calif.	1	18	Count
Been, Frank	Sequoia Nat. Park, Calif.	1	216	Count
Blauuw, Mrs. E. E.	Collins Center, N. Y.	1	26	Count
Canavan, Wm. P. N.	N. Falmouth, Mass.	1	16	Count
Clarke, R. G.	Franklin, Pa.	2	42	All plotted
Cope, T. D.	Wayne, Pa.	1	14	Count
Daniels, R. Crowly, D. E.	Parishville, N. Y.	1	554	Count

Name	Station	Nights	Total Meteors	Remarks
Galligan, Miss M. D.	Lanesboro, Minn.	1	38	Count
Gardner, Miss E. E.	Fellows, Calif.	4	1187	Count
Gregory, Rev. C. R.	Bald Mt., N. Y.	1	306	Count
Hall, Asaph	Flower Obs., Pa.	1	19	Count
Hallowan, Miss M. L.	Little York Lake, N. Y.	1	217	Count
Hansen, J.	Bittendorf, Iowa	1	12	Count
Harbutt, Rev. R. G.	Penney Farms, Fla.	2	54	Count
Huey, Mrs. E. R.	W. Chester, Pa.	1	7	All plotted
Kendell, Mrs. E.	Millville, N. J.	1	14	Count
Lawson, G. Spicer, E. H.	State Sanatorium, Md.	1	186	141 plotted
Martin, W. H.	Yosemite Park, Calif.	1	189	Count
Meeker, A. A.	Staten Island, N. Y.	2	12	Count
Phister, W. E. & E. A.	Newfields, N. J.	1	81	Count
Smith, Mrs. W. L.	Detroit, Mich.	1	14	Count
Sobelman, L.	Millville, N. J.	1	23	Count
Stebbins, Joel	Madison, Wis.	2	66	Count
Tallman, Dr. M. H.	Miami, Fla.	3	76	All plotted
Thomas, Andrew	Winnepegosis, Canada	1	30	Count
Tilburt, R.	Lansing, Mich.	2	20	Count
Tinkham, E. R.	Presidio, Texas	1	9	All plotted
Van Allen, Mrs. H.	Silver Springs, N. Y.	1	30	Count
Individuals			21	
Individuals U. S. Weather Bureau Hydrographic Office, U.S.N.	Fireballs		170	
Total		39	3796*	

*This total does not include reports published in Reprint No. 5 which came through Harvard College Observatory and not directly to the A.M.S. These would add about 3000 additional meteors to the counts.

TABLE III.

Name		Telescopic Meteors
Bouton, Rev. T. C. H.	St. Petersburg, Fla.	5
Chandra, R. G.	Jessore, India	24*
Dartayet, M.	La Plata, Argentine	71*
Dawson, B. H.	La Plata, Argentine	31*
Donner, H. F.	Bloemfontein, S. Africa	30
Flower Observatory	Upper Darby, Pa.	5
Jessup, M. K.	Bloemfontein, S. Africa	37
Logan, J. H.	Ft. Worth, Texas	14
March, F. F.	Frederick, Md.	20
Monnig, O. E.	Ft. Worth, Texas	2
Shinkfield, R. C.	Adelaide, S. Australia	1
Smith, F. W.	Glen Olden, Pa.	5
Taylor, P.	Santa Ana, Calif.	2
Whitney, B. S.	Beaver, Okla.	3
Wilson, R. H.	Swarthmore, Pa.	14
Total		264

*Includes meteors seen in 1928 and 1929, but not reported before.

Grand Total in Tables I, II, III 10,366

Flower Observatory of the University of Pennsylvania,
Upper Darby, Pennsylvania, 1930 February 20.

Fireballs Reported to the University of Iowa.

This is a continuation of the list reported in the December issue of POPULAR ASTRONOMY.

Of the fireballs observed on October 14 and 15, the Nebraska meteor falling a little before midnight on October 15 appears to have been the most widely observed. A request for information published in the *Nebraska State Journal* brought in several reports, including points both east and west of the path of the meteor.

The meteor which fell November 1 at about midnight, and which lighted up the town of Earlham, Iowa, according to newspaper reports, was observed at Iowa City by P. C. Daniels, who estimated its light as about equal to that of the full moon.

The meteor which fell at 7:35, on November 2, and which was reported first by E. M. Letts of Iowa City, has since been reported from the states of Missouri, Kansas, and Oklahoma, in addition to Iowa. It was the most widely observed of any meteor since that of July 25, 1929.

In collecting information on the above meteor, reports were received from St. Louis and points south in both Illinois and Missouri, which evidently referred to another meteor. These reports were discordant, and some of them evidently refer to the meteor which fell in Arkansas at about 9:15 on the evening of Friday, November 8. A report on this Arkansas meteor by Professor Olivier appears in the February issue of POPULAR ASTRONOMY.

The meteor of November 5, first reported from Beloit College, Beloit, Wisconsin, was also observed at the Yerkes Observatory, and with the coöperation of Professor Frost, several additional reports have been secured. Professor Olivier also mailed us one report which he received.

No further reports were secured on the meteor of November 9, the last of our preceding list.

November 23, 7:33. A meteor was observed by P. C. Daniels of Iowa City, and one additional observer has reported it.

November 27, 9:25. A meteor was observed by Professor E. C. Johnson of St. Paul, Minnesota. It was also reported by Professor C. A. Ruckmick of Iowa City, and many others.

November 28, 5:58. A meteor was observed at Beloit, Wisconsin, and also by Graham M. Dean of Coralville, Iowa.

December 5, 6:30. A meteor was observed by a student of the Iowa City high school, and also by a student of the Lanyon, Iowa, high school.

December 27, 6:0. A meteor was observed by L. W. Camp at Keokuk, Iowa, and by Robert N. Wolfe of Fairfield, who observed the meteor from Carson, Iowa.

Additional reports on bright meteors have been received, including January 1, at 8:11, January 6, at 9:05, and January 7, at 18:15.

C. C. WYLIE.

State University of Iowa, February 18, 1930.

NOTES FROM AMATEURS

Observations of Wilk's Comet (1929*d*)

Comet Wilk (1929 *d*) has made a most entertaining telescopic object for amateur observers. Through the courtesy of Harvard College Observatory in furnishing position and daily motion, the Texas Observers were able to locate the comet on the evening of December 23 at 6:26 C.S.T.—30 minutes before the abso-

lute ending of twilight as given by the *American Ephemeris*. The comet was approximately ½° south of β Lyrae, and about 1° from the Ring Nebula, which had nearly the same declination as the comet, and could be readily compared with it by only a slight swing in R.A. The Ring Nebula was distinctly the brighter in texture, but the comet was the larger, and was estimated to be one and a half to two times the diameter of the Ring Nebula, indicating a diameter for the comet of approximately 2′. An observation of the comet's motion showed that it moved its own diameter in about 20 minutes of time, and the daily motion then being almost 3°, this test showed a diameter of 2½′. Two to three minutes was also our direct estimate of the diameter with the aid of an eyepiece of small, known angular field, equipped with cross hairs.

TRAIL OF WILK'S COMET.
Compare with image of Dumb-bell Nebula, 2¼ inches in direction of trail.

Through the fortunate prevalence of two series of clear spells interrupted by clouds on only the evenings of December 31 and January 1, the comet has been observed here every night since December 23, with the exception of the evenings mentioned. It had practically no nucleus (or at best a poor one) the first evening seen, but a nucleus was more definitely present on December 24, and since that time has improved. The magnitude was estimated at 8 the first evening seen, but has since brightened to 7 and perhaps even 6, being visible in 1¼-inch finder by the evening of December 29. The comet's angular diameter has increased, but has hardly exceeded 3′ at any time.

The amateur observer will find it interesting to make careful estimates of the magnitude and diameter of telescopic comets for comparison with published reports from observatories. Estimates of "integrated magnitudes" of such ill-defined objects are of necessity more or less guesswork, but throwing the star images somewhat out of focus for comparison with the comet is a considerable help. The amateur will be surprised to find that professionals will often observe the angular diameter of a comet greater than he does, presumably because of better observing conditions and instruments of greater light grasp. At its last return, some of us watched the Pons-Winnecke Comet carefully, and by no stretch of imagination

could we ever see its angular diameter over 30′; yet it was consistently reported as having been about 1° in diameter (*e.g.*, by Van Biesbroeck in POPULAR ASTRONOMY, **35**, 412, 1927), so that the faint outlying parts of the coma, seen only under good conditions, must make considerable difference.

On the evening of December 27 the comet was only about 8′ from Albireo, and through the telescope the contrast between the flashingly definite colors of the double and the vague haziness that made up the comet formed a picture that only the observer can hope to see, for photographs could not reproduce it. Apparently the comet, as seen from points in the eastern United States or perhaps even in Europe, had passed directly between us and Albireo only a few hours earlier.

WILK'S COMET.
Image followed in Right Ascension only. Scale 1 mm = 6′

On the evening of December 30, the comet provided another interesting field by being only about 1° from the Dumb-bell Nebula, M 27. The texture of the comet was decidedly brighter than that of the nebula, though of course the latter (about 11′ in diameter) was much the larger.

The Texas Observers have photographed the comet three times, the first occasion being on the evening of December 24—an unusual Christmas eve celebration! All exposures were made on Hammer Ultra-Rapid Press plates, using the C. A. Post 5-inch photographic doublet, of approximately f. 5 ratio. The camera is mounted with a 4-inch refractor, used for hand guiding; both of these instruments are lent to us by the A.A.V.S.O. The first two pictures were made by following on a nearby star, allowing the comet to trail. The first photograph is of an exposure made December 28 from 6:53 to 7:56 C.S.T.; the second an exposure of December 29, 6:46 to 7:49 C.S.T., was made by guiding on the nucleus of the comet. Good guiding was facilitated by keeping the nucleus "occulted" behind the declination cross-wire instead of trying to keep the uncertain image of the coma centered at the intersection of the cross-wires. For lack of a slow motion in declination, the comet's southward motion had to go uncorrected, so that it left a slight trail at right angles to those of the stars.

These observations and photographs have been made by James H. Logan and G. D. Kendall of Dallas, and Robert Brown, Oscar E. Monnig, and Blakeney Sanders of Ft. Worth, who, with Sterling Bunch (temporarily at Knoxville, Tennessee), constitute the

TEXAS OBSERVERS.

Ft. Worth, Texas, January 6, 1930.

GENERAL NOTES

Professor William O. Beal who for seventeen years was an Instructor and Assistant Professor of Astronomy at the University of Minnesota, died after a brief illness, February 15, 1930.

Mrs. H. F. Newall, a well-known and highly respected personage at the meetings of the International Astronomical Union and other astronomical gatherings, died early this year at her home in Cambridge, England.

Dr. A. S. Eddington, Plumian professor of astronomy at the University of Cambridge, was elected president of the Mathematical Association, London, at the annual meeting on January 6. (*Science*, January 24, 1930.)

Edward A. Osse lectured before the German Club and Society of Technologists of Philadelphia on Saturday, December 21, his subject being "Eros in Perihelion." The lecture was well illustrated with slides from several of the large observatories in this country and abroad.

Dr. J. S. Plaskett, director of the Dominion Astrophysical Observatory at Victoria, British Columbia, is to be awarded the gold medal of the Royal Astronomical Society, it was announced before the society's meeting in London. Given annually to some outstanding astronomer, the medal represents one of the highest honors that can come to a student of the stars. (*Science News Letter*, January 25, 1930.)

Dr. Harlan T. Stetson, Director of Perkins Observatory, Ohio Wesleyan University, addressed the Franklin Institute in Philadelphia on Thursday evening, February 13, the subject being "The Influence of Sun-Spots on Radio Reception."

On Wednesday evening, February 19, Dr. Stetson lectured at the American Museum of Natural History in New York on "Eclipse Hunting." The lecture was illustrated by slides and a film showing the actual progress of the eclipse of the sun of May 9, 1929, as photographed by his expedition in Malaya. The lecture was under the auspices of the Amateur Astronomical Association.

The Royal Observatory of Belgium is preparing a new edition of the volume entitled *Les Observatoires Astronomiques et Les Astronomes* which appeared first in 1907. This work published under the auspices of the International Astronomical Union includes all the active observatories and the names of all professional and amateur astronomers with an indication as to their special line of work. A questionnaire has been addressed to all observatories and many have already replied. Those who have not as yet done so are asked to send a reply as early as possible. Those astronomers, professional and amateur, who have not

received such notice are hereby requested to send such information as is indicated above.

All communications should be addressed to Mr. Paul Stroobant, Director of the Royal Observatory of Belgium, Uccle, Belgium.

Astronomical Bequest.—The University of Texas has recently come into possession of somewhat more than $800,000 bequeathed to it by the late W. J. McDonald, of Paris, Texas, for erecting, equipping, and maintaining an Astronomical Observatory. The bequest was contested by relatives and the amount mentioned above is the result of a compromised suit. The University will proceed very carefully and slowly to plan for the future McDonald Astronomical Observatory, availing itself of the advice of the most competent astronomers.

Aurora Observed.—I saw a well-defined aurora September 6 at 6:00 P.M. and later at 8:30 and 10:00 P.M. at Chevy Chase just over the Maryland State line from Washington, D. C. It was moving very slowly toward the east. The long central beam was sharply defined on the west. It was so bright that the second magnitude stars were hid at places. The North Star was visible at all times during my observation.

HENRY D. HUBBARD.

112 Quincy Street, Chevy Chase, Maryland.

Zodical Light Notes

A correspondent asks if the Zodiacal Light appears the same to all observers. No! Since observation reports from the tropics and southern latitudes have been available it is known that the Zodiacal Light is always brightest in the tropics and as a rule it is there centrally placed on the ecliptic; in southern latitudes its apex veers off somewhat to the south of the ecliptic; in northern latitudes to the north. From whatever latitude it is observed, however, it will be seen projected against the same zodiacal constellations. As night progresses and, due to the earth's rotation, the broad western horizon light disappears, the light may be traced across the sky as a band on the ecliptic provided that the conditions are favorable. Further, while it is true that the evening Zodiacal Light is best seen between December and April and the morning Zodiacal Light during the autumn, nevertheless patient, practical observers in temperate latitudes are able to find it almost any time of the year, although when the ecliptic makes a low angle with the horizon the Zodiacal Light is correspondingly very faint.

Another correspondent asks if the Gegenschein is part of the Zodiacal Light. It is so regarded by practically all observers. The term Gegenschein (or Counterglow) was given to the roundish or oval patch of light situated on the ecliptic and on the observer's meridian at midnight by Mons. Theo T. C. A. Brorsen, Serptenberg, Germany, about 1853. Under suitable conditions Zodiacal bands can be seen joining the Gegenschein and running east and west along the ecliptic to the horizon.

During the past month the Zodiacal Light has been observed from the station on the following dates: January 19, 24, 25, 26, 28, 31; February 2, 3, 14. On all other dates the presence of the moon or of cloudy weather made observations impossible. Nothing of exceptional interest was observed except as follows: On February 3, the moon being four days old, the Zodiacal Light was traced as far as the Pleiades at eight P.M.

At that time it was quite faint and diffused as to boundary. But at nine

o'clock, the moon being then near the horizon, the Zodiacal Light stood out more plainly. On February 14 with a perfectly clear sky the Zodiacal Light was seen at seven P.M. skirting the south boundary of the Square of Pegasus and almost filling the space between that boundary and Cetus. Thence it narrowed in the direction of the Pleiades, about 80° elongation from the sun. Altogether it was of most unusual luminosity, seldom has the writer seen it so conspicuously bright, like a luminous cloud, much brighter than the Milky Way in Cepheus and Cassiopeia. At 7:15 the approach of moonrise was indicated by the brightening of the horizon below Regulus. The moon Zodiacal Light had a silvery appearance. The western Zodiacal Light was of a slightly tawny hue. The Gegenschein was glimpsed in Cancer on January 25, 26.

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BOOK REVIEWS

Popular Research Narratives, Vol. III. The Williams and Wilkins Company, Baltimore, Maryland.

This is a volume of one hundred seventy pages, containing fifty "tales of discovery, invention, and research." These narratives are numbered from 101 to 150 inclusive, indicative, as intimated by the characterization Vol. III, that each of the two preceding volumes contained fifty similar narratives also. Volume II is still obtainable from the publishers but Volume I is out of print. Anyone interested in the rapid progress being made at present in all lines of investigation will find the brief stories very enjoyable. The range of topics discussed is very large and the several papers are direct from the workers in the various fields. The articles being brief are of necessity not exhaustive, but therein lies their charm. Even the uninitiated reader can grasp the central idea without becoming lost in a maze of technicalities. After reading these narratives one may justly feel that he has, at least to some extent, become familiar with what is happening on the frontiers of the various sciences and industries.

The Development of Astro-Photography and the Great Telescopes of the Future is the title of an octavo pamphlet of sixty-four pages recently issued and distributed under the auspices of the Société Astronomique de France. The pamphlet shows the progress which has been made in the construction of reflecting telescopes through the collaboration of Professor G. W. Ritchey and the company of Saint-Gobain, makers of the glass necessary for this purpose. It also describes and gives numerous photographs of the work, which is now in process at the University of Paris, of constructing the cellular type of mirror, which has received the name of the Ritchey-Chretien type. The mechanical aspects of this new type of mirror are very interesting to all astronomers, but the greatest pleasure for astronomers comes from the almost unexcelled rproductions of nebulae, star clusters, and star clouds made with telescopes constructed by Professor Ritchey.

The pamphlet is a great credit to Professor Ritchey, the company of Saint-Gobain, and the printers. The photographs and the reproducing of them both represent the greatest of skill in the respective arts.

An unexpected feature is a photograph of a drawing of a very beautiful observatory to house a twenty-five foot telescope as Professor Ritchey has visioned it on the rim of the Grand Canyon at Desert View, Arizona.

Hilfsbuch der Astronomischen Photographie, by H. J. Gramatzki. (Ferd. Dümmlers, Berlin. $1.50.) This is a book of one hundred pages containing suggestions which will be found helpful by those who are engaged in any kind of celestial photography. The first half of the book is devoted to a consideration of the instrumental equipment used in astronomical photography in its various phases. The second half is given to a consideration of specific objects to be photographed such as the moon, the sun, planets, comets, etc., and the best procedure in each case. Finally there is a chapter on laboratory equipment which is a very useful if not a necessary accessory to the actual photographic equipment. The book is in German which necessarily limits its adaptability in this country, but on the basis of its content the book is to be well recommended.

1001 Celestial Wonders, Second Edition, by C. E. Barns. (*Pacific Science Press*, Morgan Hill, California. $2.50.) The first edition of this book was reviewed in the October, 1928, issue of this magazine. Considering the character of the book and the general interest in astronomy on the part of many persons at present, it is not surprising that a second edition should be necessary so soon. The second edition, although basically the same as the first, shows amplifications and extensions in several phases. It is impracticable to mention all the details touched in this book. Suffice it to say that in the nearly three hundred pages there have been packed a great variety and abundance of astronomical fact, and one may look with confidence for information on almost any of the well developed and standardized branches of astronomical science.

Thirteen-Month Calendar, compiled by Julia E. Johnsen. (The H. W. Wilson Company, 958 University Ave., New York City.) The arguments for and against a reform in the calendar are set forth in the two hundred pages, which constitute No. 4 of Volume VI of the series of publications known as *The Reference Shelf*. In the beginning of the book twenty-four pages are devoted to a formal outline of the affirmative and negative sides of the question of calendar reform. As twelve pages are devoted to each side one may conclude that there are as many arguments on one side as on the other. Whether those on one side are weightier than those on the other is probably to be decided only by individual judgment. Fourteen pages are devoted to a bibliography of some two hundred articles bearing on the question. The remainder of the book is given to twenty-five very interesting papers some favorable and some unfavorable to a change. That so large a body of material has grown up about this question is evidence that it is a vital one. The book is highly recommended to those who are seeking to understand the significance of a change in the calendar and its far reaching consequences.

Introduction to Physical Optics by John K. Robertson, F.R.S.C., Professor of Physics, Queen's University, Kingston, Canada. (D. Van Nostrand Co., New York, 1929. 422 pages. Illustrated. $4.00.)

In the introductory chapter the author discusses the properties of light and the historical conflict between the wave and corpuscular theories of light. The recent determination of the velocity of light by Michelson is given here for the first time, perhaps, in a text-book. Next in order are chapters on the study of wave motion (unfortunately, group velocity has been omitted), geometrical optics, the mechanism of accommodation of the human eye, the simple telescope, and dispersion.

The following section treats of the formation of spectra by the various methods of excitation, the Ritz Combination Principle, and general series relations. The simple relations between the main series are represented in diagrammatic form. Highly important is the treatment of the various influences operating to cause changes in the wave-length of a spectral line. In the chapter on interference it is of interest to note that a brief account of the stellar interferometer has been included. The succeeding chapters are devoted to the two general classes of diffraction phenomena, Fresnel and Fraunhofer, and polarization effects.

The remainder of the book deals with the electromagnetic theory of light, dispersion theory, introduction to Bohr's quantum theory and its subsequent development, excitation and ionization potentials, absorption spectra, band spectra, and concludes with an all too brief reference on wave-mechanics. The final chapter contains an illuminating account of the experimental work undertaken up to the present time for the purpose of detecting an ether drift. In order that the continuity may not be broken the author gives only the minimum amount of mathematics necessary for an understanding of the subject in hand.

The first 300 pages of the book are admirably presented. The reader will find it replete with many diagrams and many illustrative examples in addition to the problems contained at the end of the chapters. Beyond that, beginning with the electromagnetic theory of light and the remaining subjects depicting the rapid advances made in radiation and atomic structure within the last decade, the treatment is perhaps a little too sketchy and brief. One wishes that the author might have seen fit to include more material in the discussion of present day spectroscopy. Nevertheless, Professor Robertson's book is a splendid compromise between the more advanced works on physical optics ranging from Drude to Wood and the elementary texts on optics. Moreover, it has the distinction of being "up-to-date" and as an introduction to the theory of light it well merits its title. L.B.

Bahnbestimmung der Planeten und Kometen, by Dr. G. Stracke. (With 21 figures. Published by Julius Springer, Berlin, 1929. 28.60 marks.)

The book is obviously an attempt by the author to bring together all the new and revised classical, orbit methods which have appeared in European publications during the past thirty years. Foremost among these may be mentioned the recent modifications of Gauss', Encke's, and Olbers' methods introduced by Bauschinger, Berberich, Veithen, Wilkens, Merton, and Banachiewicz. Inasmuch as European computers are zealously pro-Gaussian, it is little wonder that the Laplacean methods, which have been brought to such a high degree of computational ease and accuracy by Leuschner in this country, have been omitted in their entirety.

As a member of the Astronomischen Rechen-Institut at Berlin, Professor Stracke is highly qualified in view of his considerable experience with asteroids, to present the material in a well organized form easily adaptable for computation. The omission of such irrelevant subject-matter as least squares, interpolation, and mechanical quadratures, together with the fact that the illustrative examples are much condensed renders the book less bulky, thus restricting it to one of moderate size.

The first of the six parts into which the book has been divided deals with heliocentric and geocentric motion. In the next part the author has a word to say concerning the choice and preparation of observations. The precautionary measures mentioned herein, which are of the utmost importance, cannot be too strongly emphasized, for it is through their neglect at the outset that the inexperienced computer so often comes to grief. The determination of orbits according to the

recently developed methods mentioned at the beginning of this review are each listed in turn in the third portion.

This is followed by a fourth section on the calculation of a geocentric ephemeris. The fifth part is devoted to the methods of computing special perturbations. In the final division of the book are presented the means of improving a first orbit according to the variation of geocentric distances or of the elements themselves, and the special methods developed by Tietjen. Various auxiliary tables of aid to the computer will be found in the appendix. Included also is a bibliography, in chronological sequence, of all the work that has been done on orbit theory since 1900.

This volume will undoubtedly prove to be a welcome addition to the ranks of theoretical astronomy. There is nothing like it in English. In the writer's opinion, the natural complement to such a book would be an exposé of the Laplacean methods and their subsequent development at the hands of Harzer, Leuschner, and others. L. B.

ELEMENTALS

I go up into the silent places
Of the mountains;
I stand on the utmost peaks
Of the placid hills,
And below me
In the valleys
And on the bosom of the foothills
Hangs an amethyst curtain
Of mist and smoke from the city.
Out from the east on purple sandals
Comes the evening.
Slowly the landscape
Fades,
And is one with the sable shadows.
Far to the southward
Sparkles the star Canopus,
And from all of the velvet blackness
Shine the other stars and planets.
An ancient wind
On silken pinions
Flits through the pine-tree branches—
Murmuring mystery.

I stand alone on the mountain
Save for these:
The stars, the wind and the darkness—,
And One sweet Presence,
That is God, the Eternal.

STERLING BUNCH.

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